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TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

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NINETEEN HUNDRED SEVEN

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-sixth Annual Meeting

JULY 23, 24 AND 25, 1907,

At Erie, Pennsylvania.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS
1907

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AMERICAN FISHERIES SOCIETY

Organized December, 1870.

PRESIDENTS.

1.	William Clift	1870-1871
2.	William Clift	1871-1872
3.	William Clift	1872-1873
4.	Robert B. Roosevelt	1873-1874
5.	Robert B. Roosevelt	1874-1875
6.	Robert B. Roosevelt	1875-1876
7.	Robert B. Roosevelt	1876-1877
8.	Robert B. Roosevelt	1877-1878
9.	Robert B. Roosevelt	1878-1879
10.	Robert B. Roosevelt	1879-1880
11.	Robert B. Roosevelt	1880-1881
12.	Robert B. Roosevelt	1881-1882
13.	George Shepard Page	1882-1883
14.	James Benkard	1883-1884
15.	Theodore Lyman	1884-1885
16.	Marshall McDonald	1885-1886
17.	W. M. Hudson	1886-1887
18.	William L. May	1887-1888
19.	John H. Bissell	1888-1889
20.	Eugene G. Blackford	1889-1890
21.	Eugene G. Blackford	1890-1891
22.	James A. Henshall	1891-1892
23.	Herschel Whitaker	1892-1893
24.	Henry C. Ford	1893-1894
25.	William L. May	1894-1895
26.	L. D. Huntington	1895-1896
27.	Herschel Whitaker	1896-1897
28.	William L. May	1897-1898
29.	George F. Peabody	1898-1899
30.	John W. Titcomb	1899-1900
31.	F. B. Dickerson	1900-1901
32.	E. E. Bryant	1901-1902
33.	George M. Bowers	1902-1903
34.	Frank N. Clark	1903-1904
35.	Henry T. Root	1904-1905
36.	C. D. Joslyn	1905-1906
37.	E. A. Birge	1906-1907
38.	H. M. Smith	1907-1908

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PART I.

BUSINESS SESSIONS

Transactions of the American Fisheries Society.

Tuesday, July 23, 1907.

Convention called to order at 12 m. by the Secretary, Mr. George F. Peabody, of Appleton, Wisconsin, at the Chamber of Commerce, in the Reed Hotel building, Erie, Penn.

The following program was presented:—

"*The Cultivation of Fishes in Small Ponds.*" CHARLES H. TOWNSEND, New York Aquarium, Battery Park, N. Y.

"*Planting Fish, versus Fry,*" JOHN L. LEARY, U. S. Bureau of Fisheries, San Marcos, Texas.

"*Some Observations on European Fisheries and Fish Culture,*" DR. H. M. SMITH, U. S. Bureau of Fisheries, Washington, D. C.

"*The Respiration of a Lake,*" EDWARD A. BIRGE, College of Letters and Science, Madison, Wis.

"*The Shad Work on the Delaware River for* 1907 *and Its Lessons,*" W. E. MEEHAN, Commissioner of Fisheries, Harrisburg, Pa.

"*Recent Progress in Artificial Propagation of Lobsters,*" PROF. A. D. MEAD, Brown University, Providence, R. I.

"*Experiments in Raising Black Bass by Taking the Nests Away from the Parents and Hatching the Eggs in Troughs.*" EDWARD A. BIRGE, College of Letters and Science, Madison, Wis.

"*Progress in Fish Culture During the Past Year,*" JOHN W. TITCOME, U. S. Bureau of Fisheries, Washington, D. C.

"*The Influence of Politics Upon the Work of the Fish Culturist and How Fish and Game Protective Associations May Assist the Latter,*" A. KELLY EVANS, Toronto, Canada.

"*The Need of an International Fisheries Society,*" O. T. OLSEN, Grimsby, England.

"*The Protection of the Alaska Salmon Fisheries.*" PROF. BARTON W. EVERMANN, U. S. Bureau of Fisheries, Washington, D. C.

"*The International Problem of the Proper Regulation of the Fisheries of the Great Lakes,*" A. KELLY EVANS, Toronto, Canada.

"*Time of Spawning of Rainbow Trout, and the Varieties of this Species,*" C. RAVERET-WATTEL, Director of Pisiculture, Dept. of Seine, Paris, France.

"*The Necessity of the Protection of the Adult Lobster, in Order to Maintain the Lobster Fisheries,*" G. W. FIELD, Chairman Massachusetts State Fish Commission, Boston, Mass.

"*The Necessity of the State Making Laws for the Protection of Food Fishes After Stocking Waters by the State or United States*," OREGON MILTON DENNIS, Secretary Maryland State Game and Fish Protective Association.

"*Manipulation of Salmon Eggs*," CHARLES G. ATKINS, East Orland, Me.

"*Notes on a New Hatching Jar*," FRANK N. CLARK, Northville, Mich.

Secretary Peabody: In the absence of the President, it is proper to elect a temporary chairman, which will be the first order of business. I am requested by the committee representing the chamber of commerce, to say that a souvenir is to be given to each member, and they are asked to use the badge that is included in the envelope.

Motion made and seconded nominating as temporary chairman Mr. Frank N. Clark, of Northville, Michigan.

Motion put to a vote and unanimously carried.

Mr. Frank N. Clark: Gentlemen of the American Fisheries Society: I can assure you I am very sorry our honored president is not here, but undoubtedly there will be nothing to come up at this meeting, while the temporary chairman presides, except simply to organize. What is the pleasure of the society? We will, of course not take up really our general order of business, and, as our Secretary has called the meeting to order, it is not necessary for the acting president to do so. There is present a reception committee of the chamber of commerce of the city of Erie, where we are now meeting, and we will be pleased to hear from the chairman of that reception committee.

Mr. Hamberger, chairman of the reception committee: Mr. President and Gentlemen of the American Fisheries Society: As chairman of this committee, there devolves upon me the pleasure and honor of introducing to you the former mayor of the city of Erie, the Hon. Frank A. Mizener, who will speak to you. I have the pleasure of introducing Mr. Mizener.

Mr. Frank A. Mizener: Gentlemen: As a rule I do not make apologies, but I consider that this body certainly is deserving of an apology for my presence here to-day, because you expected our honored mayor to give you an address of welcome. Unfortunately, he was called out of town, and last night about midnight my telephone rang, and the mayor and my friend Mr. Ham-

berger asked and insisted that I take his place here and welcome you to our city, which I do, with a great deal of pleasure. I hope you will be as charitable and nice as certain miners were out in the west, when one of their fellows died, and they discussed among themselves what sort of an epitaph they should put on his tombstone. They argued for some time, and finally one fellow said:—"I tell you, put on there: 'He done his damndest, angels could do no more.'" (Laughter and applause.)

I am very sorry the mayor is not here, because he is thoroughly acquainted with your interests, and I am not, and besides he is a great fisher of men. As a vote-getter there is no better man that I know of in the city of Erie. And he is a good fisherman, and I am sorry on that account that he is not here. I know nothing about fishing, not even about fishing for men, but our friend Senator Sisson is thoroughly conversant with that sort of business, and he no doubt will entertain you on that subject. But I do want you strangers to know a little about the city of Erie, and before you go away no doubt you will know more about it.

We consider that we have the gem city of the lakes, one of the most beautiful cities in this country anywhere. We have a population of close to 70,000 people, and no stranger ever came here to visit and went away that was not very anxious to come back again to our city. We consider that we are very hospitable. We sort of bank on that. We try to make every stranger who comes here feel at home. While we have quite a large city, yet everybody here almost knows everybody else. It is that sort of a town. We have here the largest boiler establishment in the world. Now, that sounds large, doesn't it; but it is the absolute truth; and we make more boilers and engines in the city of Erie than any one city in this country. Our industries are varied. We have blast furnaces, large paper mills, and all varieties of industries that have built up our city, and I want to say this to you, that I do not know of any city in this country, and I doubt if there is one, where the mechanics and the laboring men of the city own as many of their homes as they do in Erie. That is what makes it a good city, because the people own their own homes and they are interested directly in every bit of taxation

and every public work that goes on, and in every election that is the question that is brought up, and these men talk about it intelligently, and they are interested because of their pocketbook being affected, if the rate goes up or the rate goes down.

Now, gentlemen, I am authorized by the mayor to extend to you the hospitality and the freedom of this city. The gates are wide open, and we trust that you will have as good a time as you have ever had at any place that you have met. You have our best wishes, and anything we can do to further your interests and your pleasure we are only too glad to do.

I thank you, gentlemen, for your attention.

(Great applause.)

Mr. Hamberger: Mr. President, it was the aim of this committee to have the governor of the state of Pennsylvania present at this convention, but a previous engagement kept him away. However, we have with us to-day the second highest official of the state of Pennsylvania in the person of the President of the Senate, Senator E. A. Sisson, and I take great pleasure in introducing him to you. He will extend to you the welcome of the state. (Applause.)

Senator E. A. Sisson: Mr. Chairman, and Gentlemen of the American Fisheries Society: Not the second highest officer. We have a lieutenant-governor here. (Laughter.) To being president pro tem. of the senate I will plead guilty. The governor of the commonwealth, realizing the importance to the people of the United States of this industry for which you gentlemen speak, would have been very glad to be with you to-day, and he regretted exceedingly his inability to be here and to express to you his appreciation of the industry you represent and of the possibilities that lie at its door. I was requested at a late hour this morning to say a few words to impress upon you the fact that we are very glad that you are here, and that the whole commonwealth appreciates the honor you pay the state in coming within its borders to deliberate upon the questions involved in this industry.

I represent in the senate a district that is interested in the fishing industries of the state and nation, and, as such, I, too, have come to realize the importance of this industry to the people

of the nation. We all are growing more and more in recent times to see the possibilities that lie in the intelligent handling and management of the fishing industries of the nation. We, here at Erie, while we have but a very short lake frontage have come by practical experience to realize and appreciate an intelligent management of the fishing industries of the commonwealth, to say nothing about the industries of the nation. A few years ago the fishing industry here was at a very low ebb, and our fishermen could get very few of the food fish for which they searched; but Commissioner Meehan, backed up by the commonwealth, and more or less assisted by the people of the adjoining states, has attempted to stock the lake, and they have been using intelligent efforts in that direction, and accompanying those efforts we see and feel the impulse that it has given to the fishing industry, and our fishermen now come in with good hauls where before the catches were very light.

This is a subject for thought and for consideration. Therefore, in seeing what has been done here in this very short time, as we look over the waters of the state and nation and as we consider the very great and very important food to the people of the nation that is produced by the intelligent handling of the fisheries and the fishing industries, we increase our appreciation of the importance of an intelligent management and handling of the opportunities at our doors.

And so we greet you here very gladly. We appreciate the importance of your consideration, the great values,—increased values—from this source which have come to mankind from an intelligent consideration of this subject by just such men as you who are giving it thought and consideration, who have experience and opportunities, and therefore can give great impetus and great value to this industry which, in a large measure, has been neglected in years gone by, and to restock our waters, state and nation, and to supply this very important article of food to the people of the nation, is certainly a very important question. It is in its infancy, and this association is happily conceived, happily formed, and we trust that prosperity and gratification will accompany you in your efforts in this line. While we have a limited lake frontage and Philadelphia is our ocean port, of course the shad industries of the Delaware are important to us.

I don't know how many of you gentlemen are interested in that character of industry, but I presume they take it all in, don't they, Mr. Meehan?

Mr. Meehan: Yes.

Senator Sisson: We, of course, are chiefly interested in the fresh water fisheries, and in Mr. Meehan's success. We have had some questions that have shaken us up a little here. We are willing to co-operate for the best end of all, and the question of an open or a closed season upon our waters here has affected us. We realize that the fish run from one jurisdiction to another, and that the state of Pennsylvania cannot operate alone in benefiting this industry of fishing in the lake any more than Ohio or New York state can. But it is certain that the best management that can come for this very large industry upon these waters, requires that all of the states, as well as Canada, bordering upon these waters, must act together. It will not do to close at one place and open in another. It is impossible. The law should be uniform, if possible, and if you gentlemen can aid in bringing about that condition, you will have accomplished a great end. We are trying to unite with New York state, with Delaware, with Maryland, and with New Jersey, in securing regulation relative to fishing in the Delaware and Susquehanna rivers, and it is a much larger proposition of concurrent legislation than I apprehend is this industry in Lake Erie. I trust you gentlemen may be able to work out something to that end. We had a close season here, but with New York fishing, and open laws in Ohio, it would not work. It was imposing, I think, on our people here; it would not work out. They have got to work uniformly. And I tell you—the New York gentlemen—I don't know whether any of them are here to-day—but the commissioner from New York state, Mr. Whipple, of the town where your last governor came from, and Senator Alls, and two or three other gentlemen, met with our commission,—a commission of which I then was a member—for the purpose of securing legislation relative to fishing in the Delaware. The New Jersey people were there also. We had a close season. I told those people that our people had tied up their boats and taken their nets out of the water and had stopped fishing, but they looked down to Dunkirk and those New

York ports, and they were fishing there still. And I said, you can't expect us to abide by that unless you secure legislation that will give you the same close season that we have here. We cannot stick to that—the same waters, same fish—and they thought that they would get legislation; that they would have a close season on the waters of Lake Erie; but when the next following season came around they were fishing there—no such laws at all. And I will say for Mr. Meehan, because I presume most of you come in touch at different times, that he was very anxious to secure uniformity, and have Pennsylvania do her full share in bringing it about, and a little more. But we impressed him with the idea that we would not stand for it here, and I was right after him, and he had to give in. He is anxious to have the best here that is possible for Erie, but I thought he had done his full share for the state in trying to secure that end, and he had a turbulent lot of fellows up here to deal with—myself one of them, you know (laughter), and so we have the close season again. I trust, gentlemen, you may accomplish something in this line of uniformity in legislation. I thank you for your attention. (Applause.)

President pro tem.: Gentlemen of the Association, I presume many of you noticed a change in my countenance as I was sitting here, about three or four or five minutes ago. There certainly was, I felt it. While the mayor and president of the senate were giving us such a hearty welcome, I was thinking, after viewing this program here, what I was going to do, and after such a hearty welcome I did not know what I was going to give you in response. But now, as you all know, I am very glad to escort our honored president to his chair. (Applause.)

Prof. E. A. Birge, President of the Association, was escorted to the chair by Mr. Clark.

President: I think this is taking a rather mean advantage. It is not the first time that Erie has taken advantage of me, for I find that the sun gets up an hour earlier here than the railroad, and, while I had expected to get in here an hour before the time scheduled for the meeting, I find I am a few minutes late.

I greatly regret, sir, that I was not present when you were

giving us the words of welcome; because I could respond to them more readily if I had heard them, but I thank you for the words that you have spoken, and I am sure that the American Fisheries Society will greatly enjoy the meeting here, and will find it profitable.

The subject on which you were speaking as I came in, that of close season legislation for the great lakes, is one of very great importance and one of very great difficulty. I see no way to secure satisfactory results except by national legislation on the subject. We have talked concurrent legislation on the part of the states, and, in some minor particulars, we have been able to secure it. During the past winter, for example, the states of Wisconsin and Minnesota have agreed on similar legislation for the Mississippi river. It is a great step in advance, although by no means affecting so great an industry as, but an incomparably smaller industry, indeed, than that of the great lakes.

But the subject of legislation for the great lakes, involving, as it does, so many states and so many and diverse interests, is one which I believe can be handled successfully only through the national government, and I believe that the way to secure results is for the states to join in requesting legislation from the national government and to have that legislation directed and controlled by the national commissioner of fisheries, acting with the advice of the officers of the various states. Because there is no one system of laws which can be enacted that will apply fairly and justly to the different states, stretching, as the lakes do, from Lake Ontario on the east to Lake Superior on the west, and extending over a very great range north and south, with varying temperature of the water, and different breeding habits on the part of the same fish, different species of fish having different places in the economics of the different stations. For these reasons it is not possible to enact any one code of laws which shall operate fairly and justly, even over the limits of a single state. In Wisconsin, for instance, if we enact any single law applying to the state of Wisconsin, and make it extend from the southern line of the state on Lake Michigan to the northern limits on Lake Superior, we find that it fits one portion of the lakes, and does not fit the other. And, therefore, the problem of securing a rational law for the close season is one of considerable difficulty, and one

which can only be handled by the national government. I trust that the deliberations of the national society will further the interests we represent.

I thank you again for your words of greeting. (Applause.)

President: The next order of business upon our program, is the address by Mr. Meehan, in behalf of the state. (Applause.)

Mr. Meehan: Mr. Chairman and gentlemen: The duty of welcoming you on behalf of the state has been performed admirably by my friend Senator Sisson, president pro tem. of the senate. My name was placed upon the little program by the chamber of commerce here, because it was supposed that Senator Sisson, who is busy investigating the capitol, would not be here. But fortunately for us, he was present and able to do this, and, therefore, I can only simply join with Senator Sisson in giving you a hearty welcome to the commonwealth of Pennsylvania, and hoping that you will have a very enjoyable time while you are here.

I know that the reception committee of the city of Erie will do all they can to make your time pleasant, and I also desire to extend to you a welcome, on behalf of the state, and also to extend an invitation to you to visit any of the state hatcheries when your time will permit you to do so, either during the sessions, or afterwards. Should any of you desire to visit any specific hatchery in this state, if you will let me know, I will arrange that some one—either myself or some one else—will take you there and show you everything that is to be seen.

We have three hatcheries in this county, one here in the city of Erie, though not in operation at the present time, as it is for the propagation simply of lake fishes; one about twenty-five or twenty-six miles below, an auxiliary, where they propagate some bass, a new station, but at the present time there are quite a lot of small bass there; and the Corry hatchery, of which you have all heard. The Crawford hatchery, which is a new station and only just started, would only interest those of you who would like to see things as they are started. But we have some others, and wherever you would like to go we will find some one to take you there and show you everything we have to show and tell you everything you want to know.

Pennsylvania is especially interested in having you here, because Pennsylvania is especially interested in having any one come into Pennsylvania for any purpose whatever, and, secondly, because we are especially interested in the propagation of fish. Pennsylvania was one of the very first to engage in that great work, as early as 1867, and it has steadily worked and tried to keep prominently in the work, and it is considered so important to-day that the legislature of the state has made a department of it and established a cabinet position as the head of it, and we are trying to do good work, and we think we are doing successful work. We are trying to learn all we can, and if there is anything that we can teach you, we are glad to do it.

Gentlemen, I welcome you again on behalf of the state. (Applause.)

President: I express the thanks of the society for your kind words of welcome. We are glad to meet in Pennsylvania. We know the record of the state in the matter of the propagation of fish, and we know that you were one of the first states to engage in the work forty years ago. It is a long time. The propagation of fish is a very different thing to-day from what it was in 1867, when the state of Pennsylvania first took it up. And to Pennsylvania, perhaps as much as to any of the states of the union, is due the position which that industry holds in the commonwealths of this country to-day.

I thank you for your words of welcome. (Applause.)

President: I believe the next thing on the program is to adjourn for lunch, unless there is some other business.

Mr. Frank N. Clark: Mr. President, I do not think it provides in our general order of business for the President to appoint a committee on program. If it does not, I think we should have such a committee. Of course I understand the local reception committee have a program, but you will call to mind that we always have to have our own program committee to arrange how the papers shall be taken up. I think that committee should be appointed before we adjourn, because we have business to do as well as pleasure.

President: I will appoint on this committee Mr. Frank N.

Clark, Mr. Henry E. Root, and the secretary, Mr. George F. Peabody, as the program committee.

Is there any other business to be transacted this morning?

Mr. Clark: I would like to say, if there are any papers that Mr. Peabody has not a list of, the committee should know what they are and what they have reference to so that we may be able to arrange a program. So if any one has any papers that they are going to present, that Mr. Peabody has not received, just give them to him, and then we can arrange our program so that it will be ready for the afternoon session.

Secretary Peabody: It is also customary for the members to give their names to the stenographer, as a sort of enrollment, instead of calling the roll. We have four or five hundred members. It is rather unnecessary to call the entire list of names, and if those present will simply give their names to the stenographer, that records them as present.

Mr. Clark: Another thing: Mr. President, any names of new members ought to be handed in, I think, right now.

President: If there are any names, hand them in in writing.

Mr. A. C. Roberts: I will state that I have some cards that we use for that purpose, for candidates for membership, and if any members have names they wish to present I would like to have the names for membership presented on those cards.

Mr. Meehan: Before we take the recess, Mr. Hinrichs, the chairman of the reception committee, would like to speak a moment to the members.

Mr. Hinrichs: Mr. President, and gentlemen: I just wish to call your attention to the program that has been mapped out for the members of this association. At 7 o'clock this evening there will be several cars in front of the Reed House, which will take the members up to Waldemere Park, four miles west of here. It is a beautiful spot, and I know you will all enjoy yourselves there and appreciate the scenery. To-morrow morning at 7:30 sharp, there will be boats at the public dock, foot of State street, which will take all those that wish to go out onto the fishing

grounds. They will have an opportunity of seeing how the nets are set and lifted and how the fish are procured at this port. The trip will occupy probably three hours, may be three hours and a half. We leave at 7:30 sharp, and all are asked to be present, because the facilities are sufficient to take all the delegates.

Then the later part of the program you will find on the little cards which are in the envelopes, and if any changes are made we will notify the secretary of the association and he will kindly announce them at the meetings.

President: We stand adjourned to 2 o'clock, local time.

AFTERNOON SESSION.

July 23, 2 p. m. Meeting called to order by the president.

The registered attendance at the meeting of the society is as follows:

Bean, Tarleton H., *New York City.*
Berkhaus, J. R., *Hahnasburg, Phila.*
Birge, Prof. E. A., *Madison, Wis.*
Bower, Seymour, *Detroit, Mich.*
Bower, Ward T., *Northville, Mich.*
Buller, Nathan R., *Pleasant Mount, Penna.*
Buller, H. M., *Bellefonte, Pa.*
Buller, A. G., *Union City, Pa.*
Brooks, Chas. F., *Sandy Springs, Md.*

Carter, E. N., *St. Johnsbury, Vt.*
Clark, Frank N., *Northville, Mich.*
Crampton, John M., *New Haven, Conn.*

Downing, S. W., *Put-in-Bay, Ohio.*

Evans, A. Kelly, *Toronto, Canada.*
Evans, Barton D., *Harrisburg, Pa.*

Filkins, B. G., *Northville, Mich.*
Fullerton, Samuel F., *St. Paul, Minn.*

Geer, E. Hart, *Hadlyme, Conn.*
Green, Chester K., *Cape Vincent, N. Y.*
Grill, J. B., *Sherburn, Minn.*

Haas, Wm. F., *Spruce Creek, Pa.*
Hartman, Phil. H., *Erie, Pa.*
Jennings, G. E., *New York City.*
Leach, Glen C., *Put-in-Bay, Ohio.*
Lydell, Dwight, *Comstock Park, Mich.*
Mathewson, George T., *Enfield, Conn.*
Mead, A. D., *Providence, R. I.*
Meehan, W. E., *Philadelphia, Pa.*
Miller, Frank, *Put-in-Bay, Ohio.*
Morton, Wm. P., *Providence, R. I.*
Peabody, Geo. F., *Appleton, Wis.*
Roberts, A. D., *Woonsocket, R. I.*
Root, Henry T., *Providence, R. I.*
Safford, W. H., *Conneaut Lake, Pa.*
Smith, Dr. H. M., *Washington, D. C.*
Thayer, W. W., *Detroit, Mich.*
Titcomb, John W., *Washington, D. C.*
Townsend, C. H., *New York City.*
Webster, B. O., *Bellefonte, Pa.*
Whitaker, Andrew R., *Phoenixville, Pa.*
Willard, C. W., *Westerly, R. I.*
Wires, S. P., *Duluth, Minn.*

President: The first matter on the program is the report of the Secretary.

Secretary: Mr. Chairman and gentlemen, the report of the Secretary is printed, and I believe is in the hands of every member of the society, and there is nothing further to add to that report.

Mr. C. W. Willard: Mr. President, I would suggest, before going on any further with business, that those names which have been presented for membership be admitted to membership, so that they may participate in the meeting as members.

The following list of new members was, on motion duly made, seconded and unanimously admitted to membership.

Brush, Dr. H. L., *Conneaut Lake, Pa.*
Burnham, C. W., *Washington, D. C.*

Casperson, Bjorn, *Yes Bay, via Ketchikan, Alaska.*
Casperson, Thorgrin, *Yes Bay, via Ketchikan, Alaska.*
Catte, Eugene, *Langdon, Kan.*
Crampton, John M., *New Haven, Conn.*

Darrow, Charles E., *Conneaut Lake, Pa.*
Dominy, Jeremiah M., *South Haven, L. I.* (Life.)

Field, Dr. Geo. W., *Mass. Fish Com., Boston, Mass.*

Hancox, W. K., *Yes Bay, via Ketchikan, Alaska.*
Hanna, Robert, *Fergus Falls, Minn.*
Hanson, Louis H., *Yes Bay, via Ketchikan, Alaska.*
Humy, Gaston H. D., *Yes Bay, via Ketchikan, Alaska.*

Jackson, Charles, *34 Nassau St., New York.*

Mitchell, Hugh C., *Baird, Cal.*

Patching, Fred, *Loring, Alaska.*

Samson, Jas. B., *320 Lewis Bldg., Pittsburg, Pa.*
Stanton, W. C., *International Falls, Minn.*

Webster, B. O., *Bellefonte, Pa.*

(The matter of the nomination of Mr. Downing to life membership was, on motion duly seconded, left with the secretary and treasurer with power to act.)

President: We will now listen to the report of the treasurer.

Report read by Mr. C. W. Willard, treasurer, as follows:

To the American Fisheries Society of the United States of America.

Gentlemen:— I herewith submit my annual report as Treasurer from July 25, 1906, to July 23, 1907.

RECEIPTS.

1906.		
Life membership fees	$ 50.00	
Yearly dues	698.00	
Sale of reports	2.16	
		$750.16

EXPENDITURES.

1906.		
July 25—Balance due Treasurer	$ 26.78	
July 25—Dwight Lydell, stereopticon	3.25	
Aug. 3—L. W. Arnold, printing	1.75	
Aug. 3—Stamps and stamped envelopes	11.70	

1907.	
Jan. 8—1000 blank receipts	3.00
Jan. 17—Geo. F. Peabody, Sec'y, reports	315.55
Feb. 10—H. D. Goodwin, stenographer	175.35
Apr. 18—Emma L. Scheffler, stenographer	25.00
May 28—Stamped envelopes	10.70
July 20—Telegram to secretary	.60
July 23—Geo. F. Peabody, Sec'y, postage and circulars	45.16
	$618.84
July 23—Balance cash on hand	131.32
	$750.16

Respectfully submitted,
C. W. WILLARD, Treasurer.

Treasurer: Mr. President and gentlemen, it is certainly a source of great satisfaction to your treasurer, and I suppose to all of you, that for the first time since 1902 we are able to show a balance on the right side of the ledger.

President: The report will be received. I will appoint Mr. C. K. Green, of New York, Mr. W. P. Morton, of Rhode Island, and Mr. B. D. Evans, of Pennsylvania, auditing committee.

The remaining committees on nomination and on time and place of next meeting, I will, with the permission of the society, delay appointing. A number of our members have not come in, being delayed by the lateness of trains. It seems to me proper to wait for the other members before appointing committees.

The report of the program committee is in order.

Mr. Frank N. Clark: The program committee are only able to give a partial report at this time, and ask the indulgence of the association to provide a further report. We find, Mr. President and members, that we are afraid that it is going to be almost impossible to carry our program through of papers, discussions, etc., and business, and try to carry out the program of the committee on entertainment of Erie, but we will do so as far as we can. We now think that it would be better to take up this afternoon Mr. Townsend's paper on "The Cultivation of Fishes in Small Ponds," to be read by the secretary, and Mr. Meehan's paper on "The Shad Work on the Delaware River for 1907 and Its Lessons," and the paper of Mr. Oregon Milton Dennis, secretary of Maryland State Game and Fish Protective Association on "The Necessity of the State Making Laws for

the Protection of Food Fishes after Stocking Waters by the State or United States," and then fill in with some other papers later on. There are so many of these papers that we know that the Washington people and New York people will want to hear, that it has been a little hard for us to sort out what papers to take up. We could take up Mr. Meehan's shad paper now and we knew very likely he could talk on shad afterwards also.

Mr. Meehan: They have all the figures that I will give.

Mr. Clark: It is proposed to have this meeting, and do all the paper work we can this afternoon, and accept the invitation of the committee this evening, and to-morrow morning at 7:30, for the boat ride, and following that we will make another report.

President: Mr. Clark, the secretary tells me that Mr. Townsend's paper is not here. He thinks Mr. Townsend expects to be here. Suppose we substitute in place of his paper the paper of C. Raveret-Wattel.

The paper first read will be that of Mr. O. M. Dennis, secretary Maryland State Game and Fish Protective Association, on "The Necessity of the State Making Laws for the Protection of Food Fishes after Stocking Waters by the State or United States."

Paper read by the secretary, Mr. George F. Peabody.

The paper was then discussed.

Mr. W. E. Meehan, Commissioner of Fisheries, of Pennsylvania, then read a paper on "The Shad Work on the Delaware River for 1907 and Its Lessons," and the paper was discussed.

During the discussion of the foregoing paper, the question of federal supervision of all interstate waters came up incidentally and was considered as follows:

Mr. Bower: It seems to me that is one of the strong points mentioned in regard to federal supervision. It seems to me we ought to have federal supervision of all interstate and international waters. Now, that question has been talked about for the last two or three meetings of this society, and yet nothing has been done by this society. It seems to me, we ought to go about it in a systematic way. There are no dissenting opinions, and

it seems to me your resolutions committee should prepare resolutions along those lines, to be adopted by this society, requesting the boards of the several states interested to introduce at the next session of their respective legislatures a law ceding this right to the federal government. As I understand it, the federal government is perfectly willing to enact these laws and see that they are rigidly enforced, but of course they can't take the initiative. The states must do it themselves. I think it would go a long way, if this body would adopt resolutions, and it seems to me that would be a proper step for your resolutions committee to take.

Mr. Mathewson: Mr. President, I would like to see some thing done on that line. We are certainly in a position in Connecticut where we cannot get anything of that sort from our own legislature. The pound men are too strong for us, and it is only a wonder to me that any of the shad get up through the river at all. Between the pounds and the gillers at the mouth of the river, I have often wondered how any shad get through. And if it could be done by the federal government, I should like to see it done.

Mr. Dwight Lydell, Comstock Park, Mich.: Mr. Clark said he had no trouble in penning up the male shad, and Mr. Meehan also, and the gentlemen back here say they have no trouble in getting female shad. Perhaps they could get at it by penning up just the males.

Mr. Meehan: We had all the males we wanted, generally speaking.

Mr. Lydell: He said females.

Mr. Meehan: That was his experience. He had no trouble about the males.

Mr. Mathewson: Ordinarily we would not, but there were times when we would not get any males at all.

Mr. Meehan: I think it was three times the superintendent reported to me. If he were here now he could tell you.

Mr. Clark: Mr. President, I don't want them to lose sight

of the point that you can pen up the male shad, and they will ripen, but the female shad we couldn't.

Mr. Meehan: Then I should think there ought to be some way of finding that out. We must find it out, that is all.

President: If Mr. Clark is right that the chances of salvation depends on penning the female shad, your salvation is good way off, apparently.

Mr. Samuel F. Fullerton, St. Paul: I suppose you might call me a crank on this federal control business. I have felt very keenly on that subject for years. I have seen the course of states trying to pass laws, and everything turning out to be a farce. That is what it is. Minnesota, perhaps, is worse off than any other state in the Union, because we have got a water course of five thousand miles dividing Minnesota, Canada and our sister states, so that we know some of the evils spoken of here in Connecticut and in the Delaware. It seems to me the meat in the cocoanut of this paper is these nets at the mouth of the river. Get rid of them, and let the shad come up. It seems to me it would be going a long way to solve this problem. It is all important, of course, to find a way to pen the female shad. I think that ought to be persevered in, but it seems to me the first thing to do is to get rid of these netters. Don't let a net be placed in the Delaware river at the mouth in the spawning season, unless they are after the eggs. If you don't have any fish by keeping the fishermen out of there, then find other means of penning the shad. We pass resolutions every session on federal control, then the thing dies, and nothing is done. Why not have this society get out circulars and send them to every representative in Congress and every senator, urging this matter. If the society has not money enough, I will head a subscription list now with $10 to help the thing along. We must work along practical lines if we want to accomplish anything. It is all right to pass resolutions; but we want to go further than that; we must follow these resolutions up with work. Now, I have got pledged in our state of Minnesota every representative, the nine of them, and the two senators, to vote for any measure that comes up along that line. Our state passed a resolution two years ago

ceding any right we had in our waters and in the international waters—whatever rights on Lake Superior bordering on Minnesota. That is in the record.

President: I think Wisconsin has done the same thing this session. Now, let us all get together. Let every man from every state in the union go to work to secure the same sort of legislation.

Mr. Meehan: Mr. Fullerton, are the laws passed by Wisconsin and Minnesota, did you say?

Mr. Fullerton: They have passed resolutions ceding any rights they might have.

Mr. Meehan: Are those laws in what we might call satisfactory and proper shape?

Mr. Fullerton: Proper shape.

President: Aren't you speaking of two different things? The two states have passed laws ceding whatever rights they have to the national government when the national government legislates, but of course no legislation has yet been had by the national government. Mr. Fullerton can speak in regard to the joint legislation of Wisconsin and Minnesota in regard to the Mississippi river.

Mr. Meehan: I was referring to what you are saying about federal control.

Mr. Fullerton: Of course no law has been passed by Wisconsin or Minnesota. It is only a resolution ceding any rights we may have.

Mr. Meehan: Then it is ceded back now?

President: Yes.

Mr. Fullerton: With regard to fishing on the Mississippi river where it forms the boundary between Wisconsin and Minnesota, they would arrest our fishermen and we would arrest theirs, and it was pulling and hauling all the time, and finally a delegation went down there and met a delegation at Madison, and we had a uniform law passed so that the law in Minnesota

and Wisconsin is exactly the same. The same law controls fishing on both sides of the river, and it works very satisfactorily. But the trouble is that we could not get all the states; we could not get Iowa, and could not get Dakota, and could not get Canada where it forms the boundary line. The trouble is that we fall short of what we want. We want the government to take charge, not only to propagate the fish, but plant them.

Mr. Clark: Mr. President, I don't know if we are talking on this paper—may be we are. I understand Minnesota has passed resolutions ceding back any rights, for instance to Lake Superior, when the United States government will pass laws to regulate it. Minnesota and Wisconsin have done that. If Michigan had done that this last winter, Lake Superior could be under the control of the national government.

Mr. Fullerton: That is right.

Mr. Clark: The question, Mr. President, between the Dominion of Canada and our government is a matter to be taken up between our government and the Dominion of Canada. The question first is to get the states to cede this right back. Now, if Michigan had done this last winter, then Lake Superior could be under control of the national government and the Dominion of Canada. That is what we want. Now, Mr. President, while I am on my feet, speaking about circulars and sending them around, wouldn't it be better for this society to take some action, adopt or pass resolutions, if you please, that a certain bill that they might draw up would be what they would recommend to the National Congress for passage? Wouldn't that be something to the point?

Mr. Fullerton: Mr. President, the Shiras Bill is already before Congress.

Mr. Meehan: Mr. Chairman, I would suggest this: That this society, sometime during its meeting, either appoint a special committee to draft a bill, or a resolution similar to that drafted or passed by Minnesota and Wisconsin, to be given to the state commissions or departments of the various states, to be presented to the legislatures of the various states to be passed.

Mr. Fullerton: That is good.

Mr. Meehan: I think that would meet the point. Have a special committee appointed to draft a uniform bill to be given to each commission in each state for presentation at the next session of the legislature. I will say frankly that if such a bill is handed to me it will be handed to the legislature.

Mr. Fullerton: All that is necessary is to pass a resolution by each state government, ceding any rights they have,—not a complicated bill at all, simply a few words. But the Shiras Bill covers the point we want. If anybody wants to read it, it can be gotten in the American Field, Forest and Stream of last May or June. That covers every point that we are contending for. Mr. Shiras has gone into it very fully.

President: I should like to say that we passed resolutions a year ago, and probably on earlier occasions, "that there should be federal control of boundary streams, and that the states concerned should cede their rights to the national government. We heartily commend the efforts of Mr. George Shiras."

Mr. Fullerton: That is the man.

President: We have passed resolutions, and a copy of the resolutions was to be sent to each member of Congress. I suppose that was done.

Mr. Henry T. Root, Providence, R. I.: Mr. President, they only apply to these interstate waters. It would not apply to inland waters like Connecticut. If we find a man putting a trap or nets at the mouth of a river where shad run up, or any other fish, to spawn, we make them remove it. Now, we are going further, or trying to go further with the pound nets. Under our law, the harbor commissioners, if they find an obstruction to navagation, can have it removed, and the pound nets are getting so large there that we are trying to show that they are an obstruction to navigation, and we will get rid of the pound nets in that way. The United States allows navigation, even to naphtha launches, or anything else; they own the waters and nobody has any right to place an obstruction in them,—that is, in salt waters. I think if Connecticut had our laws they could control the migra-

tion of those fish in those rivers entirely. We control it that way. We have some shad streams and they are doing nicely.

Mr. Meehan: We have a law in Pennsylvania which forbids the obstruction of fish, but that will not apply to nets which the law allows to be used, unfortunately.

President: Any further discussion? We might as well finish our discussion of federal control. If there is anything further to be said on that, take it up at this time.

Mr. Bower: Mr. President, you said a resolution of that nature had been passed by this society, directing that a copy be sent to members of Congress. I do not see what effect that has, sending it to members of Congress. They have nothing to do. It seems to me it should be handed to the state boards of fish commissioners and state wardens, and that they be requested to introduce this resolution; that the secretary of this society should be directed to correspond with the various boards and see that the resolution is introduced. The resolutions passed heretofore have covered a great variety of subjects. I do not know of this exclusive resolution ever having been passed by this society—it has been loaded up with a lot of other things, as I recollect it, and it seems to me it should be confined to just that point and nothing else, and the secretary see that what this society has done is communicated to the proper persons, and I think we will get results.

Mr. A. Kelly Evans, of Toronto: In regard to Lake Michigan, where state control is exerted, how far or near does the control begin?

Mr. Clark: Clear over the Wisconsin line. They chase the violators clear into Wisconsin.

Secretary Peabody: On Lake Michigan, for example, there would have to be cooperation by Illinois, Michigan and Wisconsin. That would settle that lake.

Mr. Clark: Settle Lake Michigan.

Secretary Peabody: Then it seems to me that Wisconsin and Michigan, both deeply interested could, through

their fish commissions and those interested in the subject, bring Indiana and Illinois into line, who have little or no interest in it now. Because they have no interest in it now, it would be very easy, to get them to pass such a law, it would seem, and that matter could be settled right there.

Now, again, the matter of the Connecticut river is apparently a local matter. There is no other state interested, and it is purely Connecticut's business to do that. Let them stop netting at the mouth of the river. If they don't want shad, that is not anybody else's business. It is purely a question of where there are a number of states interested, and it seems to me that this society can do very little. It is a question that is up to the board of commissioners of these different states. Perhaps a little effort could be made by this society to get the representatives of these fish commissions to attend our meetings. We have none from Indiana; none from Illinois, I believe, at this meeting, and, of course, these states do not show very much interest in it; but Michigan and Wisconsin both have a deep and vital interest, because it is a matter of great importance to them, and those two states together could easily control Lake Michigan. Now, Lake Erie has again Ohio, Pennsylvania, New York, and that is all.

Mr. Clark: About eight states.

Secretary Peabody: Eight?

President: For all the lakes.

Secretary Peabody: No, not all the lakes—five states. They could get together and handle the matter. I do not see how this society can do any better. Resolutions have been passed from time to time. Agitation is valuable, of course, but if there should be a congress of the fish commissions of the states interested, they might work out a law that would be uniform.

President: There was a meeting held in Chicago two years ago by the commissioners of the states bordering on the upper lakes, at all events.

Secretary Peabody: In this connection, I will say that a gentleman in Canada interested in this subject has been cor-

responding with me, and promised to be here to talk upon this very subject.

President: Was that Mr. Evans?

Secretary Peabody: A. Kelly Evans. He was very much interested, and I supposed he would be here yesterday.

Mr. Clark: Speaking of the meeting in Chicago, I was at that meeting in Chicago. They have passed resolutions and done everything, Minnesota and Wisconsin have done something; the other states have not. Now, that is all there is to it. They have started the ball. Michigan has not, Illinois has not, Indiana has not, Ohio has not, Pennsylvania has not. At every single meeting of whatever nature, whether it was the commissioners from the states and members of the Legislature, they were all there, and they had a bully good time. They are always unanimous and together and all harmony, and everything else, just as we are here to-day, but they don't do anything—except Minnesota and Wisconsin—and they have, and I say there is the start. They have done something, let the other states get to work and do likewise, and I do not think there will be any difficulty about congress passing the bill.

Mr. Fullerton: No trouble at all.

Mr. Clark: Now Ohio wants to go at it, Michigan wants to go at it, and get the states to pass that resolution, if they have got the right one, ceding back to the national government. Then there is nobody to blame.

Mr. Bower: I don't just agree with the Secretary, that this society cannot do anything. I think it would have a good deal of influence if the secretary was directed to keep track of when the legislatures convene and at that particular time would forward to the state board, or the several boards interested, a copy of the resolution passed by this society, as it would call their attention to the matter. A good many of the members of the state boards are not salaried men; they could not be expected to take up the matter unless their attention is called to it; and when they go before the committees, after this resolution is introduced, it is a very potent, a very powerful argument which

they will have, that this is the sense of the American Fisheries' Society. I know it will have a large influence, and be probably one of the chief arguments they would use. If their attention were called to it and the secretary was directed to see that their attention was called to it at the proper time, I am satisfied that it would have a good deal of influence.

Mr. Fullerton: I thoroughly agree with Mr. Bower. I think it pays to advertise, and everlastingly keep at it and we certainly get before the people by that means. Secretary Peabody and I do not agree, when he says Connecticut is the only state interested in the shad fishing down there. I take issue with him. I am just as much interested in that as they are. I think we are all interested together, all the states. What affects the shad fishing affects us up in Minnesota,—we get cheaper fish. The same with the whitefish interests and the trout interests of Michigan. Down there in Michigan perhaps they are more interested locally, but we are interested also. The more fish they catch in Michigan and other places, the better it will be for Minnesota.

Secretary Peabody: I did not mean to make quite so sweeping a statement. I mean they would have to work out their own salvation.

Mr. Meehan: Is it in order to introduce a resolution?

Mr. President: It is.

The following resolution was then read by Mr. W. E. Meehan:—

It is moved that a committee of five be appointed which shall draft a resolution on the lines adopted by the legislatures of Minnesota and Wisconsin, ceding control of fishery legislation to the federal government, and the secretary of this society is directed to forward a copy to the fish commission of each state with a request that it be introduced at the next session of the legislature, and that every effort be made to have it passed, and the committee is directed to report before the close of the present meeting.

Mr. Clark: Mr. President, I second the resolution.

President: You have heard the resolution read. Do you desire to have it read again? It is open for discussion. If there is no further discussion, I will put the question.

Question put and motion carried.

President: The chair will have to consider the constitution of that committee for a few moments, unless the maker of the resolution has any suggestions.

Mr. Meehan: No, let the chairman appoint a committee.

President: Mr. Townsend, whose paper was set down by the committee for this afternoon, has just come in, but would like to have his paper go over to a later session, and if there is no objection from the program committee, we will take up a paper by E. Raveret-Wattel, Director of the Fisheries Station of the Nid de Verdier, Fécamp, France, on "Observations Regarding the Varieties of Rainbow Trout and the Time of the Spawning of This Species." If there is no objection, the secretary will read this paper.

Secretary Peabody: I might say this is a literal translation from the French.

The paper was read by Secretary Peabody and discussed.

Mr. Clark: Mr. President, I would like to inquire from the Treasurer or some one, what members here have registered, and how many.

President: There have been thirty names registered so far. There are a considerable number here who have not registered, and I would suggest that they register at once.

The treasurer is ready and willing to receive all moneys that are coming.

If there is no further business, the session stands adjourned.

Mr. Clark: Until tomorrow morning at 7:30 on the dock.

President: The program for to-night is to go out to Waldemere Park.

Wednesday, July 24.

The members were entertained by a trip on Lake Erie, at the invitation of the entertainment committee, in the fishing tugs, to witness the setting out of nets and taking in a haul of fish.

AFTERNOON SESSION.

July 24, 2 p. m. Meeting called to order by the president.

President: Before hearing the report of the program committee, I will announce the committees which I announced yesterday would be named at this time.

Committee on Resolutions: I appoint on that committee, Mr. W. E. Meehan, Harrisburg, Pa.; Mr. S. F. Fullerton, St. Paul, Minn.; Mr. S. Bower, Detroit, Mich.; A. Kelly Evans, Toronto; G. T. Mathewson, Enfield, Conn.

Committee on location: Mr. J. W. Titcomb, Washington, D. C.; Mr. E. N. Carter, St. Johnsbury, Vt.; Mr. W. W. Thayer, of Detroit, Michigan.

Committee on Nomination: Mr. Seymour Bower, Detroit, Mich.; Mr. S. W. Downing, Put-in-Bay, Ohio; Mr. A. D. Roberts, Woonsocket, R. I.; Mr. C. H. Townsend, N. Y.; Mr. E. H. Geer, Hadlyme, Conn.

President: Is there any miscellaneous business which ought to precede the reading of the papers.

The auditing committee on treasurer's report, made the following report:

We, the undersigned auditing committee, have examined the account with vouchers of C. W. Willard, treasurer, and find the same correct, with balance on hand of $131.32.

(Signed) C. K. Green.
William P. Morton.
Barton D. Evans.

President: The report of the auditing committee is before you.

Motion to adopt report, made, seconded and unanimously carried.

The following telegram was read by the secretary: "George F. Peabody, Reed House, Erie, Pa., I propose to honorary or corresponding membership Charlie Poutiau of Lommell, Belgium. C. G. Atkins."

It was moved and seconded that the nomination sent in by Mr. Atkins be referred to the incoming executive committee, with power to act.

Motion carried.

President: Is there further business of this character which should be taken up now? If not, we will listen to the report of the program committee.

Mr. Clark: The program committee have a further report to make along the lines of papers. It is proposed to take up for this afternoon's session Mr. Townsend's paper on "The Cultivation of Fishes in Small Ponds;" Mr. Leary's paper on "Planting Fish vs. Fry," and in connection with that, Dr. Birge's paper on "Black Bass," and other black bass papers and discussions. Then Mr. Clark's, "Notes on a New Hatching Jar;" Mr. Titcomb's paper on "Progress in Fish Culture During the Past Year;" and Dr. Smith's paper on "Some Observations on European Fisheries and Fish Culture;" and Mr. Olsen's paper on "The Need of an International Fishery Society," and Mr. Atkins' paper on "Manipulation of Salmon Eggs," if we have time; with the discussions. And for this evening, Mr. President and gentlemen, we find that Dr. Mead's paper on "Recent Progress in Artificial Propagation of Lobsters," requires the lantern slides. Therefore, that lecture will occur immediately after the banquet. The banquet will be over with at 8:30, only an hour and a half, so the chairman of the committee on entertainment says, and then we will adjourn from the banquet room to a larger room where they will have lanterns and everything provided for that lecture.

I have made a mistake. Dr. Bean's paper is also to be taken up.

President: I have not the title of Dr. Bean's paper, I believe.

The report will be accepted unless there is objection.

Motion made that the Chair read the program.

President: The program reads as follows: The first paper will be that of Charles H. Townsend of New York; the second, that of John L. Leary, on "Planting Fish versus Fry;" the third paper is that set down for myself, but it is not a paper as a matter of fact, on certain experiments with regard to black bass; the fourth paper is Mr. Clark's on the Hatching Jar; the fifth Mr. Titcomb, "Progress in Fish Culture During the Past Year;" the sixth Dr. Smith on "Some Observations on European Fisheries and Fish Culture;" the seventh, Mr. Olsen, of Grimsby, England, on "The Need of an International Fisheries Society;" the eighth, Mr. Atkins on "Manipulation of Salmon Eggs," and ninth, Dr. Bean's paper on "Practical Difficulties in the Way of Fish Culture."

The question is on the adoption of this report.

Motion made, seconded and unanimously carried adopting the report of the committee.

The first paper then will be that of Mr. Townsend on "The Cultivation of Fishes in Small Ponds."

Mr. Townsend then read his paper which was discussed.

Secretary Peabody then read a paper by Mr. John L. Leary of San Marcos, Texas, on "Planting Fish vs. Fry," which was exhaustively discussed.

In reference to his paper on "Experiments in Raising Black Bass by Taking the Nests away from the Parents and Hatching the Eggs in Troughs," President Birge said:

I am going to begin with a personal matter. I wish to inform the society that my name is not Elias, as stated on the program, but Edward. I wrote to our Secretary, however, that if he could keep Ananias away from me I would not object to his posting me by any other name that he pleased. He seems to think I naturally belonged in the Old Testament; and he seemed to think that I ought to give you a paper, when I wrote to him that I had not got one. I told him that I had hoped to be able to report on this subject of taking the nests away, and say something that would interest the society, but that I found it would be impossible, owing to the lack of facts on the subject; but he, with the abounding faith that he is distinguished for,

in spite of my telling him that it was impossible, placed the title on the list.

I shall hope to say something on this matter next year.

Secretary: Mr. President, there are a couple of notes here from gentlemen who ask some questions on the small-mouthed black bass. It might be pertinent to bring them in.

The questions were then submitted and discussed.

Mr. E. H. Carter of St. Johnsbury, Vt., then read a paper on "Bass Ponds," which was discussed.

Mr. Frank N. Clark of Northville, Mich., then read a paper entitled "Notes on a New Hatching Jar."

The paper was discussed.

Mr. John W. Titcomb, U. S. Bureau of Fisheries, Washington, D. C., will send for publication a paper on "Progress in Fish Culture During the Past Year." Mr. Titcomb mentioned and described the Robinson device for measuring eggs, and then related the following interesting incident in nature study.

If you will allow me, by way of diversion—as you have been having a good deal of serious talk, I will refer to an article which I had the pleasure of reading in one of Mr. W. J. Long's very interesting books, "Northern Trails," about which some of you have undoubtedly heard, on the subject of the salmon. Mr. Long, as you know, and Mr. Roosevelt have had a little tilt on natural history. But Mr. Long has now wandered in the fields of the fish culturist, and he tells in a most interesting way the story of the salmon. He prefaces his book by stating that all of the statements are the result of his personal observations, or based upon information by very reliable guides, except the history of the salmon in the sea. We therefore pass over the history of the salmon in the sea, and read with intense interest the wonderful leaps of the salmon as it descends the stream. In fact, there are a great many interesting stories narrated by Mr. Long in his very interesting way, until he arrives at the spawning ground, when the fish perform their usual functions, and, as he states, the eggs are left to a gently flowing current.

This is the part that will interest you; "The current of water passed continually over the hidden treasures. * * * Beginning his life with hunger, he had at first eaten all that was

left in the egg besides himself and was nibbling at the shell when it broke and let him out. * * * As the egg covering wavered on his tail, he whirled like a wink and swallowed it." (Laughter).

President: Any discussion on Mr. Titcomb's paper? (Laughter). If not, we will pass to that of Dr. Smith on "Foreign Methods of Fish Culture."

Dr. H. M. Smith, Deputy U. S. Fish Commissioner, then read a paper on "Some Observation on European Fisheries and Fish Culture," which was discussed.

Mr. Tarleton H. Bean then delivered an address on "Practical Difficulties in the Way of Fish Culture," which was discussed.

Mr. Clark: I would like to say before adjournment that the committee on program have gone over things as carefully as possible, and with one or two exceptions where they may be printed without being read, I think that if the society will adjourn at the present time to meet at nine o'clock to-morrow morning they can probably get through with their papers.

President: Allow me to say that my paper can just as well be omitted.

Mr. Clark: I was going to say that we only have to consider the papers of Dr. Birge and Mr. A. Kelly Evans of Toronto. Dr. Mead's paper will be read to-night; of course you will understand that. Mr. Evans' paper on "The Influence of Politics upon the work of the Fish Culturist, and How Fish and Game Protective Associations May Assist the Latter," and also on "The International Problem of the Proper Regulation of the Fisheries of the Great Lakes," will be read. Then there is a paper by Mr. Field, chairman of the Massachusetts State Fish Commission. That paper really ought to go along with the paper of Professor Mead to-night, I should presume. Those are practically all the papers, with the exception of the paper by Mr. Atkins on the "Manipulation of Salmon Eggs," and the report on "Foreign Correspondence," which Dr. Smith informs me will only take a short time, and then there are one or two

others here that we may perhaps have time to take up. I think we will have no difficulty in getting through by to-morrow between twelve and one, so that those who wish to leave in the afternoon may do so.

Dr. Smith: There is a provision in our constitution, for miscellaneous business. Before adjournment, please give me two minutes to present a resolution.

Resolution read by Secretary Peabody as follows: Whereas, The American Fisheries Society, in annual meeting at Erie, Pennsylvania, has learned with regret of the continued illness of our fellow member and pioneer fish culturist, Livingston Stone, one of the founders of the society; therefore,

Resolved, That we send greetings to our stricken associate and extend our sincere sympathy to him and his family.

Resolved, further, That the secretary acquaint Mrs. Stone with this action of the society.

Mr. Clark: I move the adoption of the resolution.

Motion seconded.

President: I think it would be proper to adopt this resolution by a rising vote.

Resolution carried unanimously.

President: The secretary will transmit the information regarding the action of the society.

The society stands adjourned until 7:30 p. m., for the banquet.

Proceedings at the Banquet held at the Reed House in the City of Erie, Pennsylvania, July 24.

Mr. Meehan of Philadelphia acted as toastmaster.

Mr. Meehan: Gentlemen, someone once said, "Eat, drink and be merry, because to-morrow you go fishing."—or something to that effect. (Laughter). About a year ago, or just about a year ago, we met at Grand Rapids, and there the question came up of where we should meet the next year. I had the hardihood to propose the city of Erie in Pennsylvania. There was some little doubt about whether it was good policy to come to Pennsylvania—(Cries of "No doubt about it now").—for

fear the city of Erie might be a backwoods town; but after some little persuasion, it was agreed to, and the invitation of the chamber of commerce of the city of Erie and of certain of the newspapers was accepted, and we are now here. I would therefore, like to have Mr. H. T. Leasure, the secretary of the chamber of commerce of Erie, tell us how it is that he has had so much of the milk of human kindness as to bring us here and give us such a hearty reception as we have received here.

Mr. H. T. Leasure: Mr. Toastmaster, Ladies and Gentlemen: I am sorry that your toastmaster has made the mistake of the evening in starting out by calling on me to address you, for I assure you that if my position depended upon my ability to talk, I would not have it for twenty-four hours.

Again it is rather hard, after sitting down and partaking of a meal like this, not knowing that you are going to be called upon, to be suddenly subjected to an ordeal like this. I don't know it from practical experience, but I have heard it said that a man cannot talk well on a full stomach, and I have eaten a very hearty meal. That makes me think, of course, of a little incident that I read, where one of our humorists was traveling, and he went into the diner and sat down opposite a lady with a small child about four years of age. The child was taken care of by the lady, and got what it wanted to eat, and afterwards got cross and acted rather badly, and he made the remark if he had a child which acted like that, he would give it a good spanking. The mother replied, "I do not believe in spanking a child on a full stomach. He replied, "No, I think you might turn it around." And I think if I could have spoken before I had a full stomach, I could possibly have said something. (Laughter).

I assure you, that it has been a great pleasure for the chamber of commerce to entertain you. We have had a great many conventions in the last four years, invited here by the chamber of commerce. We have always tried to please them. I do not know of any instance where they have gone away not pleased with our entertainment and their treatment.

I may say that this convention is not as large as we expected, but what it lacks in number, it has surely made up in quality. I do not think we have ever had a more representative

crowd of men at a convention in our city than the American Fisheries' Society convention. (Applause).

Although few ladies have honored us with their presence, I have been told that it is not customary for the ladies to attend these conventions; but we urged that the invitation should be extended, and we were in hopes that quite a few might have accepted, and, as in the case of the gentlemen, although you are not here in great numbers, I assure you you have the quality in what you have presented here. (Applause.) In appearance they can't be beat. (Applause.)

I tried to persuade the toastmaster to call on some of the other Erie gentlemen, as we have a few here who can speak, but he said, "I do not know them very well, and I do know you, so I am going to call on you first." I told him I could talk probably two minutes and that would be the end of it.

I hope that in the future when any of you gentlemen are coming through to the west, or from the west to the east, you will find it convenient and to your pleasure to stop off in Erie. I would deem it a pleasure to show you through our town I assure you that we have not had the opportunity to show you our city as we would like to show it to you. It seems as though your program is long, and you do not seem to be able to spare the time to take in much pleasure. But, if at any time after this convention, you are able to stop in this city, I will take pleasure in showing you over it. It is a beautiful place. I assure you our people welcome you here. We enjoy the reputation of being one of the most hospitable cities in the state of Pennsylvania. We have had a great many conventions, and they go away well pleased from our city, and are always willing to vote to return, and I hope that we may in the near future entertain you again. I thank you.

(Great Applause.)

Toastmaster: This afternoon, during one of the intermissions, I was out on the sidewalk, and I was hailed by my friend Commissioner Bowers. He said, "Look here Meehan, I want to speak to you a minute, and if you are a good friend, you will do what I want." He said, "I hear you are going to ask me to speak to-night and I don't want to do it, because I know my

family don't like me to do such things; but I will tell you what you can do, you may call on Smith, he likes that sort of thing." I will, therefore, call on Dr. Smith, as the representative of Mr. Bowers. (Applause.)

Dr. Smith: Mr. Toastmaster, Ladies and Gentlemen: this is a mean trick, (laughter) and I promise you that I will get even with Commissioner Bowers one of these days. I want to take as the subject of my toast an epistle I got a short time ago from a citizen of the commonwealth of Pennsylvania. It was more than a coincidence, perhaps almost an inspiration, that on the eve of my departure from Washington to Erie, I should receive a letter, which I believe will rank as one of the most remarkable documents that has ever passed through the United States mails. It is quite evident that this communication was intended for the consideration of the members of the American Fisheries' Society, but it contains some matters of local interest, which lead me to believe that it should finally reach the department of fisheries of Pennsylvania. This is the communication,—and one of the special features about it is that the postal authorities, realizing the firm hold that Pennsylvanians have on Uncle Sam, were willing that this should go through the mails without a postage stamp, (laughter) but that is not all—the form of this letter certainly deserves consideration. It is on two sheets, which I will now exhibit. (Laughter.) More remarkable than the form is the matter. I shall have to withhold the name of the correspondent, also his address, because somebody might become offended; but I should like to read this letter and leave it to you to ponder over:—"Can't you raise salt water fish in fresh water rivers and cross them in ponds in Pennsylvania? Can't we cross the herring that run up rivers with the shad and make them larger? Put in fresh water ponds gradually, do it gradually. We have fruit crossed and made to grow larger. We have horses, birds, etc. crossed for better stock. In California a man is crossing fruits and flowers, using hypodermics of sap and blood. Try a hypodermic syringe. Cedar and pine, evergreen trees, saps into maples to make them keep in leaf all winter, and make a manure that will make cedar trees, arbor vitae, gum trees, and persimmon trees grow faster. Send me word,

please, when this is accomplished. I think all this should be patented, and the patent right sold, and that I should be given a share in the profits." (Great laughter.)

This Pennsylvanian makes my speech for me. (Laughter and applause.)

Toastmaster:—The letter is almost equal to one which I received some time ago when the news got abroad that our trout had sore throat and the department got a letter, "Try camphor." And that reminds me that when the chamber of commerce made up its list of members of the reception committee, they did not forget to put thereon several people who are intimately connected with fish work, and one of them was the Chairman, Mr. Hinrichs. Now, I think that those of us who live upon the borders of the great lakes, and perhaps all of us, would like to know very much how Mr. Hinrichs, or his captains, manage to keep themselves free from the Canadian revenue cutter.

Mr. Hinrichs: Mr. Toastmaster, Ladies and Gentlemen: This is another surprise. I understood that in the speech making to-night no member was to be called upon.

I can say that we have not had trouble with the Canadian authorities. We have had the pleasure of hearing from the Ontario Game and Protective Association, and the head of that association, after he realized the amount of propagating that the state of Pennsylvania had done, said, that he did not blame the Yankees for crossing the line occasionally to get some of the fishes which had been planted by them. But in mapping out the program, there is one feature that we overlooked, a feature that would have made Erie prominent in the eyes of the world, namely, we should have carried out the idea of getting Captain Dunn of the Canadian boat Vigilant posted as to the proposed trip of Commissioner Meehan on the lake to-day. I want to tell you confidentially that the boat did not return until two o'clock. Now, there is no boat that can go out in the direction which that boat did and stay until two o'clock without crossing the Canadian line. If Captain Dunn had been informed of the proposed attempt to cross the line to-day, we would not have had the pleasure of Mr. Meehan's company this evening; he would be in the custody of the Canadian authorities.

I want to say to you that it has been a sincere pleasure for the committee to entertain you. We regret that your program has been so long that you could not take in all the opportunities that we had provided for your entertainment, and if you should ever come back to Erie, which we sincerely hope will soon materialize, you will be welcomed heartily. We hope your convention will meet here again inside of three years. We assure you, you will never have a better time. Notwithstanding the fact that the next international convention will meet at Washington, D. C., Erie cannot claim of course to out do Washington with all its attractiveness, but, year after next we hope you will be with us again, and whatever committee has charge of arranging the convention at that time, I hope will bear this in mind.

I thank you for the pleasure you have given us, in the opportunity of entertaining you, and we will always fondly remember your visit to this city. (Great applause.)

Toastmaster: There are two or three questions that come before the Fisheries' Society, which have, by common consent, usually been barred. One is the German Carp, and the other is Fry vs. Fingerlings. Now, if our friend Bartlett was here, I would call on him to tell what he knew about carp, just for the fun of the thing; but, as he is not here, I think we will call upon Dr. Birge to tell us how he kept the meeting to-day from getting into a row over fingerlings and fry. (Applause.)

Dr. Birge: Mr. Toastmaster, Ladies and Gentlemen: I really do not know how I succeeded in doing that, but I think I did it in a masterly manner. I have presided over this meeting with a good deal of trepidation, and when the subject of Fry vs. Fingerlings came up, I thought I was in for it sure. When I get into an assemblage of university men that are engaged in managing the affairs of universities, I generally feel that I can at least keep quiet with dignity, because I know something about what is going on. But when I get in here with a lot of practical fish men who are actually doing things in the matter of breeding fish and taking charge of the larger affairs of the fishery industries of the country, I feel myself a good deal at sea, and I am always afraid that somebody will get after me, somewhat as the

New Jersey farmers did after a former governor of our state, Governor Hoard. If there were more than one representative of Wisconsin here, or if I were not more than five hundred miles from home, I should not dare to tell one of his stories because he tells them very admirably and I very badly.

Governor Hoard was down in New Jersey at a clam-bake—not of the variety of clam that our Rhode Island friends gave us, but the little neck clam. He was called on for a speech at the close of the clam-bake; he referred to the bivalve of which he had been partaking, and referred to it as the "low neck" clam. One of the old farmers said: "It ain't low neck, it is little neck." Hoard gave him a glance and went on with his "low neck" clam to the end of the speech; but when the speech was over the old farmer came up and said: "Governor Hoard, I reckon you don't have many clams out there in Wisconsin." The Governor says: "No, we certainly don't; they don't do very well; it is a prairie state, and driving the clams across the country to water, they get foot sore, so we don't raise a good many clams out there." The old farmer was so astonished that he simply exclaimed "Gosh!" and after leaving asked," Is that man governor out there in Wisconsin?" When told that he was, the farmer commented, "Well, he may be all right for governor of Wisconsin but get him down in New Jersey and he ain't much better than a d——d fool." (Laughter.) Now, I have been afraid all the time, especially when this question of fry and fingerlings came up, that somebody might say that I was all right as fish commissioner of Wisconsin, but when I got in with practical fish men, I was an ignoramus. So, Mr. Toastmaster, I think you will agree that I concealed my ignorance in a masterly way; and I assure you if you will bring up the carp question to-morrow, I will do the same thing and conceal my lack of knowledge as capably as I did this afternoon.

Before sitting down, I want to express the thanks of the society to Erie for the admirable entertainment they have given us, and I wish to express our regret that we could not take all of the pleasant trips and share in the pleasant amusements which were so hospitably planned by the reception committee. But we have enjoyed thoroughly those trips which we have been able to take. I was especially glad that the practical fishermen here entered

into the spirit of the meeting and demonstrated to us the practical workings of the netting industry which is so important to this city and the fisheries of the great lakes.

So we wish to express our thanks to the committee, and our hearty enjoyment of everything they have done for us, and our sole regret is that they have planned so much which we have been unable to enjoy. (Applause.)

Toastmaster: Many years ago, when I was first introduced into the mysteries of fish culture, I met a gentleman who at that time was deeply involved in the subject, and we have become very firm friends; and I know we will continue so until the end; but nearly every time I see him, and that is about once every six months, he is in a new business; and I think we would like to have Dr. Tarleton H. Bean explain to us just what his business is.

Dr. Bean: Mr. Toastmaster, Ladies and Gentlemen: I am blessed if I know. It is very difficult to tell just what business may come up in a fish country. I suppose that fish culture does take up a great part of my time. But I certainly have had a great deal of trouble of late with some of my constituents from Missouri—you remember, I am from Missouri. I was born in Pennsylvania and moved to Missouri, and cast my first vote in Missouri. Well, out in Missouri, going out with my dear old friend the chairman of the fish and game committee of the exposition, fishing down in the Ozark mountains, I heard a fairly good story. There is a country in the middle of the state, in which the inhabitants are not thoroughly familiar with the English language, and they depend upon the general store keeper who is also the postmaster, to give them the news. He reads the weekly paper and explains it to them. So he is the translator of the current news of the weekly paper. This man was reading the paper one day to his townspeople, and among the items of interest that he read was the following: "There is going to be a great slump in the price of corn, owing to the great influx of immigrants in this country." They listened to it, and said: "Well now, what is an immigrant? What does that word mean?" He always had an explanation ready, or tried to have, so he scratched his head and thought awhile. He didn't know what it meant

himself, but he had to pretend he knew—just as we do sometimes—and finally said: "An immigrant, I know what that is, it is not quite so big as a raccoon, a little bigger than an opossum, but hell on corn." (Great laughter.)

That is just the way with us in the present business of fish culture. We come across this little immigrant, brought from Europe, or Great Britain, or New Zealand—wherever we may happen to get a supply, new elements for the American fish, and this miserable little immigrant plays smash with our native species. We have lots of cases of that kind—little observed—that sweep in among our trout and sweep them off by the tens of thousands. And so we should be obliged to our Missouri friend, who has so carefully explained to us the meaning of the word "immigrant." (Applause.)

Toastmaster: There is a little state in the Union called Maryland, and they have got some peculiar things down in Maryland. It is a jolly little state to get into, I will tell you, but there is one thing I know we should all like to know about, and that is, how it is that the fish commissioner of Maryland managed to get an appropriation of $4000, to buy eels to furnish the legislature with annually. I will ask Mr. Brooks for an explanation of that apparent anomaly. (Laughter.)

Mr. Charles F. Brooks, Sandy Springs, Md.: Mr. President. Ladies and Gentlemen: I am not an after-dinner speaker, in any sense of the word. I never undertake to make a speech. The question Mr. Meehan has asked me, I cannot answer at all. But I can tell you all one thing, and that is, if you come down to Maryland—that good old place where they have the terrapin, canvas-backs and oysters and all manner of eatables, to say nothing of hog and hominy and backwoods cakes, you will never regret it. He came down there and we entertained him the best we could; took him out on the rivers, those beautiful rivers along the bay, and did not undertake to drown him or do anything of a serious nature to him.

Now I want to tell you how different his treatment was of me, when I started to come up here, and I lay it all to him. I would like to know, if anyone can tell me, why he wished to treat a gentleman from Maryland in this way. In the first place, in the

still watches of the night, he placed a freight train on our track and let us run into it full speed. I have secret information that he was at the bottom of that whole thing. (Laughter.)

Mr. Meehan: I had to give you some excitement.

Mr. Brooks: I fortunately escaped that and came on here, and he then tried to kill me with good cheer, but he found out that by good treatment I only prospered. So to-day he took me out on this beautiful lake out here and gave me a pleasant outing, very pleasant—most of the time. (Laughter.) He showed us how the nets were taken up and how the fish were secured—very few of them I must say—he will have to come down to Maryland in order to get many fish. Then he showed us how they were put down. But for some reason some of the members of the party did not feel very comfortable, and when I appealed to the commissioner, his treatment of me was not what I expected. I wanted him to give me something to do me some good, to raise my drooping spirits; instead of that he sang the old song to me. The quotation was applicable, Commissioner Meehan. And the commissioner said to me: "There are plenty of fish down in the brook; all you need is a line, a rod and hook." I believed him that there were plenty of fish, and all wanted to come out very badly. I had a most uncomfortable time. The commissioner found that I even survived that trip out on the lake, and to add insult to injury, he gave me no ticket to-night to this banquet, expecting me to go supperless to bed. If any of you can explain that treatment I shall be very glad to have you do so. (Applause.)

Toastmaster: I will leave it to any man in this room whether or not he deserves a ticket to this banquet, because while we were out on the boat and while he was uncomfortable, I offered him a good plump, fat ham sandwich, and he rejected it. (Laughter.) After that, naturally I supposed he didn't want any supper or dinner.

The hour is growing late, and we have some other work to do, but we have one or two speakers who should have something to say about things of interest. Among other things, it has been a well known fact that for many years the American Fisheries

Society has owed its treasurer a good fat sum. I understand now, that he has got his money back, and I would like to know how he worked it.

Professor Birge: He has gone upstairs.

Mr. Meehan: I will have to pass him by then.

As a conclusion I would like to hear from the president of the chamber of commerce of Erie.

President Arbuckle: Mr. Toastmaster, Gentlemen of the American Fisheries Society and Ladies: I have certainly enjoyed meeting with you gentlemen during this convention, and we are glad to have you with us. What I know about the city of Erie would take a good while to tell. One of the things that I can say to you is that we have a chamber of commerce consisting of over nine hundred members, and every one of that nine hundred wishes you welcome to the city of Erie, and hopes you may come again.

We have a city that has entertained some notables, and we are glad to have you come here too. We consider the American Fisheries Society as among those notables. We think that they have done a great deal for Erie. We think that when they have stocked the lake with whitefish and made it possible to take 75,000,000 pounds of whitefish out of Lake Erie in a year, that the American Fisheries Society has done something for Erie. I know that there are a great many fishermen here. I know that they make their living out of the product of that lake, and I know that we owe their prosperity to a great extent to the stocking of the waters by the fish commission.

As regards Erie, we have a very prosperous city, a very large manufacturing city. We build more boilers and engines here in Erie than any other city in the world, and have the largest shops in the world for that purpose. We are getting ready to welcome the General Electric Company, which will build a very large factory here in the immediate future, and we expect to have others follow them. Our prosperity has been coming to us for a long time, but more particularly in the last six or seven years, since the chamber of commerce was organized. Of course we have other civic bodies here, but none of them as large as the

chamber of commerce. They have all joined together, and we have got together, and we are all ready to welcome you when you come again, gentlemen, and we hope that it may be soon. (Applause.)

Toastmaster: I know that we would all like to stay a little longer. I know there are a number of experiences of our people which we would like to hear and know, but the hour has arrived when we must get down to business, and I hereby declare this banquet closed. The members and friends here will go to the large room on the floor above, where the president will call the meeting to order, and the business will proceed. It will be a lecture by Dr. A. D. Mead on "Recent Progress in Artificial Propagation of Lobsters," which will be illustrated. (Applause.)

After the banquet the meeting adjourned to the lecture room in the Reed House, where Professor A. D. Mead delivered an illustrated lecture on, "Recent Progress in Artificial Propagation of Lobsters," which was discussed.

Recess until next day, same place, 9:30 a. m.

Thursday, July 25.

Meeting called to order by the president.

President: Is the committee on location ready to report?

Mr. Titcomb: Mr. President, may I see the 1905 report? (Report submitted to Mr. Titcomb.)

Mr. Titcomb: The committee on location finds that they have very little to do. At the meeting of the society in 1905, a resolution was adopted which I now read for your clear understanding: "Whereas, the American Fisheries Society, in annual convention assembled at White Sulphur Springs, West Virginia, has learned of the action of the International Fishery Congress in designating Washington, D. C., as the place of meeting for the next congress: therefore

Resolved, That this Society hereby expresses its gratification at the honor thus conferred on the United States by the body of dis-

tinguished foreign authorities composing the late International Fishery Congress.

Resolved, That we pledge our individual and united efforts to promote the success of the Washington Congress, and will accord all practicable assistance and support to those having charge of the arrangements.

Resolved, That at the proper time the president appoint a committee of seven members to officially represent the society at the Congress; the said delegates to represent the different geographical sections of the country as far as practicable.

Resolved, That the Society hold its regular annual meeting at Washington in 1908, in conjunction with the International Fishery Congress."

Your committee therefore recommend that, pursuant to this last resolution, the next meeting of the Society be held in Washington, D. C. That the meeting be called on Monday morning, September 21st at 10 o'clock, to be continued from that time as long as necessary to complete the business. On this subject, I think Dr. Smith can give you some information, which will make this date appear the desirable one for holding the meeting.

President: We shall be glad to hear from Dr. Smith.

Dr. Smith: Mr. President and Gentlemen: I have no very definite views as to the course of procedure in the case of this double meeting to be held in Washington next year. I should not favor the merging of the American Fisheries Society in the International Fishery Congress. I think we should hold an independent meeting. But, in order that the meeting may not be unduly prolonged, it seems to me that we should be willing on this special occasion to condense our proceedings as much as possible; have all the essential business conducted and have presented such papers as are of rather local interest, leaving papers of more wide-spread interest to be presented at the International Fishery Congress.

The International Congress has been called for Tuesday, September 22nd, and the sessions will continue for four or five days. It seems to me, Mr. President, that there is reason to believe that owing to the peculiar conditions attending the next meeting of the society, there should be one of the most interesting and important gatherings ever held in this country in connection with and in interest of fisheries.

I believe all of the members have received copies of the an-

nouncement in regard to certain awards which have been offered by the International Fishery Congress. This Society has offered an award of $100.00 for a certain purpose. I hope, for the honor of the society and of the country, that the members will compete freely and will carry off a large number of these awards. Certainly there are no people in this country or anywhere else who are better qualified to enter this competition than the members of this society.

President: The question is on the adoption of the report of the committee on time and place of meeting

Mr. Clark: Mr. President, I move the adoption of the report of the committee.

Motion seconded.

Report adopted unanimously.

President: Is the committee on nominations ready to report?

Mr. Seymour Bower: I will say that the committee on nominations had a very harmonious and pleasant meeting, and the selections that were finally decided upon were unanimous in every instance; although I might except our treasurer: one of the committee rather protested against him. I do not know why, unless it is that he is in the same state and knows him better than any of the rest of us. And I do not feel just right about renominating him myself. He stated at last year's meeting, that if there was a deficit, he would meet it, and I understand he has done so a number of times. He also stated that if there was a surplus, he would divide it, and he has not been around to see the committee on nominations yet. (Laughter.)

The nominees finally decided upon were, for president, Dr. H. M. Smith, Washington, D. C.; for vice president, Dr. Tarleton H. Bean of New York; for recording secretary, George F. Peabody, of Appleton, Wis.; for corresponding secretary, Charles G. Atkins, of East Orland, Maine; for treasurer C. W. Willard, Westerly, R. I.

For the executive committee, the following:

Chairman, W. E. Mechan, Harrisburg, Pa.; G. T. Mathewson, Enfield, Connecticut; Frank Miller, Put-in-Bay, Ohio; G.

V. Jennings, New York; Dr. S. P. Bartlett, Quincy, Illinois; Dr. G. W. Field, Boston, Massachusetts; W. P. Morton, Providence, Rhode Island.

The committee has no further report to make, except that we earnestly recommend the adoption of the report.

(Signed) Seymour Bower.
Chairman Committee on Nomination.

President: The question before you is, on the adoption of the report.

Motion made and seconded that the report be adopted.

Report adopted unanimously.

Motion made, seconded and unanimously carried that the rules be suspended and the secretary be instructed to cast the ballot of the society for the nominees.

The secretary so cast the ballot and the president announced that the nominees were duly elected to their respective offices.

President: Is the committee on resolutions ready to make its report?

Mr. Meehan: I would like to have the privilege of presenting our report in sections, as the exigencies of the occasion arise. Two or three things have come up, and we can very likely fix it in that way.

President: Very well.

Mr. Meehan: I would first like to read the resolution in regard to the passing away of a number of the members during the year.

Resolution read by Dr. Meehan as follows:

During the year our ranks have been depleted by the scythe which is no respecter of young or old. Their work and counsel will still be at our command, but no longer will they in person inspire us to new achievements. However, we can go along the paths that they have hewn out; and the world may not know except in this tribute that we pay, how much they did to better the world that they lived in. It is we that have known them personally, who fully appreciate their work; but, like the tiny coral insect, who builds up his nest that in time makes an island,

these men have added to the knowledge that gives to fish culture its potentialities as one of the great sources of the food supply of the struggling millions of the world.

Those who have gone from among us are:

C. J. Bottsman, Burgen Op Zoom, Holland, 1906; John H. Howell, New Bern, N. C., August 1, 1906; S. H. Kauffman, Washington, D. C., 1906; George F. Lane, Silver Lake, Mass., July 17, 1906; George A. Wride, Grindstone City, Mich., August, 1906; Bernard L. Douredoure, Philadelphia, Pennsylvania, spring of 1907; Fred J. Adams, Grand Rapids, Mich., spring of 1907.

Mr. Meehan: The resolution is offered for passage.

Mr. Clark: I move the adoption of the resolution.

Motion seconded.

Resolution adopted unanimously by a rising vote.

Mr. Meehan: The committee on resolutions desire also to offer the following resolution for adoption:

Resolved, That the thanks of the society be cordially given to the chamber of commerce of the city of Erie, its reception committee, and the citizens of the city of Erie, and commonwealth of Pennsylvania for their royal entertainment, the courtesy extended, and their hearty and abundant hospitality.

Mr. Clark: I move the adoption of the resolution.

Motion seconded.

Resolution carried unanimously.

Mr. Meehan: The committee would like to have a recess for a little while.

President: Is there other business to come before us at this time?

Mr. Clark: The committee on program would simply make as a last and final report, the statement that the balance of the papers to be read are, Mr. G. W. Field's on "The Necessity of the Protection of the Adult Lobster, in Order to Maintain the Lobster Fisheries;" Mr. Charles G. Atkin's on "Foreign Correspondence," and on "Manipulation of Salmon Eggs;" Dr. Birge's on "The Respiration of a Lake;" and Mr. A. Kelly Evans' on "The Influence of Politics Upon the Work of the Fish Culturist,

and How Fish and Game Protective Associations May Assist the Latter;" also on, "The International Problem of the Proper Regulation of the Fisheries of the Great Lakes;" and we would move that the balance of the papers be published without reading.

President: Those in favor of the adoption of the report as read, will say "Aye".

Opposed, "No".

Report adopted unanimously.

Dr. Smith: I should like to bring to the notice of the society, a communication from Mr. R. B. Marston, editor of the Fishing Gazette, London, England. He is greatly interested in the American Fishery matters, and I believe the members of the society will be glad to have this communication from him in regard to striped bass:

"We hope to try the striped bass in our waters. Would it be troubling you too much to tell me what would be the best way to try the experiment? If the striped bass could beplanted from the Atlantic to the Pacific, why not from one side of the Atlantic to the other? Perhaps you know some man well up in striped bass, who would undertake to get together some striped bass of both sexes, and ship them to us at Southampton, probably from Providence. If you know of such a fish culturist, please give me details, as I shall have to send the hat around and get the money, and must know before hand what the expense will be. My friend the Honorable Daniel B. Fearing, of Newport, R. I., is also a member of this society, and has promised me five pounds of bass; and I hope to have little trouble in getting the money. Our British Sea Angler Society has at last gotten interested. I have been advocating the trial of this splendid game fish for two or three years."

Mr. G. W. Field, Chairman Massachusetts State Fish Commission, then read a paper entitled "The Necessity of the Protection of the Adult Lobster, in Order to Maintain the Lobster Fisheries," which was discussed.

President: Do you wish to present any resolutions at this time, Mr. Meehan?

Mr. Meehan: Yes.

President: Then we will hear from the committee on resolutions.

Mr. Meehan: The committee has directed me to present the following resolution:—

Resolved, That the secretary of this society be directed to prepare and forward a copy of this resolution to the fishery officials or other proper officials of the several states interested, with the request that they have the same presented to the next session of their legislature and use every effort to have it adopted:

Resolved, by the Senate and House of Representatives of the State of ....., in Assembly met, that the State of..... cedes to the National Government any right or title it may have or jurisdiction over the fisheries in any waters forming the boundary between this and any other state so far as this state has jurisdiction and also over the fisheries of the waters of the Great Lakes which form a boundary line between this state and a foreign government.

President: I would be glad if that might be read once more.

Resolution reread by Mr. Meehan.

Mr. Meehan: I should say that the committee knew, in fact, that in some states this would not be exactly correct. It would not be for our state, for instance, so far as the Delaware River is concerned, because we would have to add to that that this shall go into effect when the state of New Jersey passes a similar law. There is a treaty by which they have concurrent jurisdiction, and consequently it would be a concurrent resolution between the states; but this was merely some sort of a formula for a draft of a resolution.

President: We will consider this resolution. The question is on the adoption of the report by the committee. Are there any remarks on that? The phraseology of that resolution, is, I am sure, somewhat different from that which we passed in Wisconsin; and I do not believe that would have passed, although it amounts to nearly the same thing. Would it not be a good plan to have the secretary make his letter deal with the general subject of the cession of control, and then submit, by way of showing what has been done, copies of Minnesota and Wisconsin resolutions, rather than try to make a formula, as though we had a particular formula which the society wanted to have adopted?

Mr. Meehan: Mr. Chairman, this resolution was drawn in accordance with the instructions of the society. The society instructed this committee to draft a bill or resolution to be presented to the various state legislatures. That was why this was done in this way.

President: The question is on the adoption of the report. Those in favor say "aye," opposed "no."

Motion carried.

Mr. Meehan: I am directed by the committee to present the following resolution:—

Resolved, That this society reaffirm its resolution adopted at its meeting at Grand Rapids, Michigan, last year, in support of the Shiras bill giving federal control of boundary waters.

President: The question is on the adoption of the report.

Those in favor of the adoption of the report will signify by saying "aye," opposed "no."

Motion carried.

Mr. Meehan: I am requested by the committee to present the following resolution:—

Whereas, for several years, the members from the state of Rhode Island have presented suitable souvenirs to the members of the American Fisheries Society at its meetings, therefore,

Resolved, That the sincere thanks of the society be extended to the Rhode Island members, together with a sense of its appreciation of the feeling which prompted the gifts.

(Applause.)

Resolution voted upon and carried unanimously.

Mr. Root: I think that resolution ought to be more personal, and confined to Mr. Roberts entirely. If he has a bill, we will pay it. But it is his idea in presenting these souvenirs.

Mr. Meehan: I am directed to present one more resolution, but the committee would like to hold this resolution until Mr. Evans of Toronto has said what he has to say.

President: I will call on Mr. A. Kelly Evans, of Toronto, for his paper on "The International Problem of the Proper Regulation of the Fisheries of the Great Lakes," and also take up at the same time, his paper on "The Influence of Politic

Upon the Work of the Fish Culturist, and How Fish and Game Protective Associations May Assist the Latter."

Mr. Evans delivered an address on these subjects, which was discussed.

Mr. Meehan: The committee has directed me to offer the following resolution for adoption:—

Resolved, That it is the opinion of this society that immediate steps be taken in the direction of using its influence to call an international conference of representatives of the sovereign states, bordering on the great lakes; the province of Ontario, the Dominion government and the Federal government at Washington, for the purpose of discussing means, measures and regulations of a uniform character to improve the fisheries of the great lakes and the waters adjacent.

President: The subject is now open for discussion by the society.

Mr. Meehan: That concludes the report of the committee on resolutions.

Mr. Fullerton: Would it not be a good idea, to have the secretary of the American Fisheries Society, send a communication to the governors of the different states, requesting them at a certain date, to name a representative to meet a like body from Ontario and Canada? Would we not get at the matter directly in that way, by having our secretary here do that; that would be official.

Mr. Meehan: Do you make that as an amendment to that resolution?

Mr. Fullerton: I am not criticising the resolution, but it strikes me that would be a good way to get at it directly, and accomplish something; have the secretary write to the governor of each state bordering on the great lakes—I think there are eight or nine states directly interested—to meet the representatives of the Dominion and Ontario governments.

President: It seems to me that this is intended to be an informal meeting. I gathered from Mr. Evan's paper that an informal gathering was desired first.

Mr. Evans: I think the idea of the committee on resolutions was, while it was to be informal in a sense, at the same time that the representatives would be largely the officials connected with the bureaus of the different states. Was not that the idea?

Mr. Meehan: That was the idea.

Mr. Fullerton: My idea was that this committee that was to meet a like body from Ontario and the Dominion of Canada —it would not be binding—they could not bind the different states to anything.

Mr. Meehan. Yes.

Mr. Fullerton: But they could lay a foundation, and recommend to the Dominion government and to the government at Washington their recommendations; which would be, in my estimation, a good deal more binding than if the other was taken up first. Let us have a preliminary meeting, if you wish, of the states interested first with the Dominion and the Ontario governments, and then with the other two governments afterwards.

President: If it is desired to accept this amendment, it will be so considered.

Mr. Meehan: I am instructed by the members of the committee, to accept that as an amendment to the resolution that was offered; rather, to add it to that, as it is not an amendment now.

President: It stands a part of the report.

Mr. Meehan: That the secretary of the society be directed to request the governors of the states bordering on the great lakes, the president of the United States, and the governor general of Canada and the lieutenant governor of Ontario, to appoint on a certain date, delegates to this international conference.

President: I would point out that this throws upon the president and secretary of the society the burden of making all the arrangements for this conference.

Mr. Meehan: I think it will come on the executive committee, Mr. President; they transact business in between times—apart from the secretary's writing this communication.

Mr. Evans: I think another advantage, Mr. President, in doing it in that way, is that of course, if delegates were appointed by such powers, naturally the expenditures would not fall upon the individuals present. I mean that if the province of Ontario department sent over any delegates representing them, naturally, the province of Ontario would foot the bill. It would not be any expense on the fisheries societies.

President: I should like to hear from Dr. Smith. I should like to ask whether it is the experience of those who are familiar with such matters, as I am not at all, whether governors and presidents and governor generals, will appoint official representatives on the invitation of a society which has a scientific standing like our own, or will respond better to an official invitation from somebody having governmental standing. I would like to hear from Dr. Smith in regard to the matter.

Dr. Smith: I cannot speak for the states, but I think in the case of the United States Bureau of Fisheries, that we should be glad to designate delegates for this purpose. I hope this set of resolutions will pass. But I would call attention to the fact that for twenty years there have been conferences held between the states and the United States on one side and the Dominion government and the provinces of Ontario and Quebec on the other, and so far as I know, there has never been any result from those conferences—no tangible result. It is possible that this time, the conditions are such that some good may be expected, and I hope that this is the case.

Mr. Meehan: Mr. Chairman, I can speak for the past in the state of Pennsylvania in regard to that matter, at least in one instance. Some years ago, an invitation was issued for an international convention or meeting in Florida of the governors of the states, and the governor of Pennsylvania appointed delegates from Pennsylvania to that convention, of which I was one, made it a proviso that there should be no expense, and so on.

Mr. Evans: Would it be possible, for the original steps to be taken by the administration in Pennsylvania? If this invitation merely proceeds from this society, as a scientific body, it might not have the same practical results in weight as if it proceeded from the commonwealth of Pennsylvania.

Mr. Meehan: Of course I cannot answer that question very well; but I would be very glad, if this society desires to ask the governor of the commonwealth of Pennsylvania to issue an invitation of that kind to present the request to the governor of the state. But of course, I cannot answer as to what the outcome of that would be in this instance. It is, I think, rather a dangerous procedure to take. Of course if he did it, it would be all right; if he did not, it would in a measure give a black eye to the whole affair, because it would go out that the governor of the State of Pennsylvania declined to issue any such invitation as that, and give the idea that he was opposed to such a thing, whether he was or not.

President: That question came into my mind in saying what I did. Would it not be, on the whole, the most advantageous method to adopt a resolution favoring the calling of such a meeting substantially as the committee reported it, and to leave to the executive committee the ways and means of promoting such a meeting? A large share of the business must be transacted by that committee in any event, and if they find a method that is more advantageous than any other, it seems to me, they should put that into effect, rather than be bound by the vote of the society, which has not had proper time for consideration of the subject.

Mr. Meehan: I think that is a good idea.

President: If there is no objection on the part of Mr. Fullerton or the other members of the Society, it will be understood that the resolution will be amended or changed by the chairman, committing to the executive committee of the Society the arrangement of details and so on for the meeting.

Mr. Fullerton: I have no objection at all to that change. I want something done, that is all I care. I do not want this to

fall into the hands of the executive committee, go along, and then have nothing done.

Mr. Meehan: I think I can speak for the executive committee this year.

Mr. Fullerton: That is good. That is all I want to know.

President: Is there further discussion of this subject? If not I will put the question. Those in favor of adopting the resolutions following Mr. Evans' paper will say "aye," opposed "no."

Resolution carried unanimously.

Mr. Fullerton: Mr. President, I have another resolution I would like to introduce now. I do not like to leave it to the chairman of our resolutions committee, because his ancestors were born in Ireland, and he shares some of their national characteristics, and, with the consent of the association, I will read that resolution.

The resolution is as follows:

Resolved, That the thanks of the American Fisheries Society is extended to the Hon. W. E. Meehan, commissioner of fisheries of the state of Pennsylvania, for the many courtesies extended during our stay in the City of Erie. We want Mr. Meehan to feel that his efforts to make our stay pleasant are appreciated, and the thanks of the Society are hereby tendered Mr. Meehan for his many acts of kindness, in making our stay a pleasant one.

Mr. Fullerton: I move the adoption of the resolution.

Motion seconded.

Question put and resolution unanimously carried.

Mr. Meehan: Mr. Chairman, this comes like an unexpected blow; I am caught in the part where there is the least resistance. I think the resolution was unnecessary. I take an interest, you all know, in the work of this society, and whatever I have done, has been done with my whole heart and soul, and I think I have done no more than my duty, no more than Dr. Birge, no more than Mr. Willard, no more than Mr. Peabody or Dr. Smith or any other member of the society has done, and it seems to me invidious to have selected me from the others for this special honor, for an honor I consider it. I thank you.

President: Is there anything further in this general order of business. If not, we will pass to Mr. Atkins' papers. You have them Mr. Secretary. One on "Foreign Correspondence," and the second paper is on "Salmon Eggs."

Dr. Smith: In the absence of Mr. Atkins, who is the chairman of this committee on foreign relations, and the disability of Mr. Titcomb, who is the next ranking member, the duty of presenting this report devolves upon me, and in view of the length of the report and shortness of our time, I do not intend to read it unless the society insists.

This is a report that abounds in good things, and I feel that the members will get the most good out of it by reading it themselves in the proceedings. I say this because I had little to do with its preparation, and therefore cannot be accused of being egotistical.

I would like to mention one or two features of the report, however, so that you may anticipate what you have coming.

There is a very interesting account of the progress of fish culture in France, based on recent government communications, and this is followed by a special paper by Mr. Titcomb giving his personal observations on fish culture in France. A subject that has been creating a great deal of attention on the continent of Europe is the feeding of salmon. That is also a subject in which Mr. Atkins has taken great interest, and you will find in this some exceedingly suggestive points.

Among the subjects treated under that head are, live food for fry, food for fingerlings and yearlings, food for brood fish, and the forcing of the growth of animals by the administration of special kinds and large quantities of food—forcing for market purposes and also for brood purposes.

There is also a very interesting chapter on the utilization of earth worm as food for trout, and it is recalled that Darwin estimated the number of worms in two and a half acres of ordinary moist land at more than 130,000, equivalent to 100 pounds of angle worms to the acre. I may say that these chapters on the feeding of salmonoids represent the latest European opinion on the subject.

There is a point of some local interest that I would like to

mention in connection with the progress of fish culture in Argentina, about which we have heard a good deal from Mr. Titcomb, and other sources. The inauguration of fish culture in our sister republic is attributable to the interest taken by the United States government, and we are therefore gratified at the results. On the occasion of the visit of Secretary Root to Argentina last winter, he was given a banquet in Buenos Ayres, at which American brook trout was served. These fish had been hatched from eggs sent from this country in 1903, I believe. Mr. Tulian, who is national fish culturist of Argentina, writes that the American trout commenced spawning a month earlier in 1907 than in 1906, and up to the 10th of June of this year, he had collected 200,000 brook trout eggs, nearly all from pond fish, as there were no suitable nets for catching the wild fish in the streams. A friend of Mr. Tulian states that he had personally caught, with hook and line, about 200 nice brook trout from little streams which ran through the field near his house, and he further states that his small boys had put a gunnysack across the narrow part of this stream and gone upstream and driven twenty-three nice trout into the sack. They have already adopted American methods down there.

A short time ago Mr. Tulian's men found an eight-inch lake trout on the shores of one of the lakes, and Mr. Tulian states that many of the lakes in the region contain brook trout and lake trout as well as landlocked salmon.

One of the most significant pieces of information that the committee on foreign relations has to communicate, is with reference to New Zealand. Members of the committee are aware of the long-continued efforts of the people of New Zealand to introduce fish into that island, and the success of the planting of rainbow trout among other fishes is well known. The local government has received from the United States government many consignments of eggs, most of which were taken over by Mr. Lambson of our society, and Mr. Ayson, the New Zealand Fish Commissioner, who is one of our corresponding members. Mr. Ayson writes us that the sockeye salmon and the chinook salmon have been successfully acclimatized in certain streams, and that spawning fish have recently returned in large numbers.

The report of the Chairman of the committee on Foreign Relations is as follows:

SECOND ANNUAL REPORT

OF THE

COMMITTEE ON FOREIGN RELATIONS.

In this, its second report, the committee on foreign relations begs to present to the Society interesting matter pertaining to the last International Fishery Congress, held at Vienna, the proceedings of which have been received since the first report of the committee; to the fishculture of France, Argentina, New Zealand, and Japan, and to the important subject of food for fishes under culture, which is treated in a series of subjoined extracts and translations from foreign publications.

The International Fishery Congress at Vienna, 1905.

This Congress belongs to the system organized at Paris in 1900, the sessions of which are now held at intervals of three years, the next session having been appointed for 1908 in the city of Washington.

From the introductory pages of the report of the Vienna Congress we extract portions of the code of rules and the entire program.

Extracts from the Code of Rules.

Purpose of the Congress. The Fishery Congress shall consider all fishery matters of importance and general interest, and submit propositions and memoranda relating thereto, to governments, provincial authorities and other officials.

Membership. The members of the Congress are representatives of governments, members of the permanent International Fishery-Commission, delegates of domestic and foreign societies and corporations, persons invited by the president of the congress, and individuals from any country who can show their interest in this organization, and declare their accession to the Congress.

Organization. The Fishery-Congress constitutes an official member of the series of International Fishery-Congresses and adheres to the provisions of the regulations pertaining thereto establisht in Paris in 1900. The president and general secretary of the congress are to be chosen by the Austrian Fishery Society (Fischerei-Verein). The vice-presidents are chosen by the Congress from among its members.

Means. The financial means at the disposal of the Congress for the execution of its purposes are: grants of governments and local authorities; contributions of members, which are fixt at 10 Kroner ($2.00) each, representatives of governments being excused from these contributions.

Business Methods. The Congress conducts its proceedings in full session and the participants may address it in German, English, French or Italian.

Subjects Considered.

1. Statute-regulation of Fishery matters.
2. International statistics.
3. Tariffs and balance of trade.
4. International regulations to protect the waters against pollution.
5. Recognition of fishery rights in the construction of water-works.
6. Results of scientific research on the following lines:
   a. Hermaphroditism in fishes.
   b. The distribution of the freshwater fishes of Europe, including Siberia.
   c. The nutrition of fishes and the signification of the plankton.
   d. The migrations of the several species of sturgeon in European waters.
   e. The migration of eels, herrings, sardines and sardelles with special reference to their spawning season.
   f. The species of salmon and their migrations.
   g. Results of investigations into the question of determining the age of fishes by their scales.

h. Observations on the spawning season of rainbow trout.

i. The value of fish as food.

7. International organization of biological research, and the fundamental principles governing the erection of biological stations.

8. Fisheulture:

a. Cultivation of freshwater fishes in open waters.

b. Pond-culture.

c. Cultivation of sea-fishes.

d. Cultivation of crawfish.

e. Cultivation of oysters.

f. Cultivation of ornamental fishes.

g. Fishways.

h. The introduction of foreign species of fish.

i. Cultivation of fishes and other water-products in Japan.

9. Diseases of fish.

10. The crawfish pest.

11. Instruction in fishery matters.

12. The training of professional fishermen.

13. Scheme for the organization of professional fishermen.

14. Societies in the fish trade.

15. Transportation.

16. The fish trade:

a. Means of increasing consumption.

b. Regulation of markets.

17. Use and abuse of the drag-net in small bays.

18. Sport-fishing in its relation to commercial fishing, fishery economy, political economy, popular recreation and popular education.

19. Motion introduced by delegate Dr. Fankhauser of Switzerland relative to the collection and publication of international annual statistics of the catch of salmon in the Rhine and other rivers tributary to the North Sea and the Baltic.

The report of these transactions forms a volume of over 400 octavo pages and constitutes an exceedingly valuable contribution to the literature of fish and especially of fisheulture. With

the exception of a single paper in French, all the proceedings are in German.

Among those taking part in the proceedings were representatives from Australia, Baden, Chili, Denmark, Finland, Germany, Holland, India, Ireland, Italy, Persia, Roumania, Russia, Sweden, Switzerland, Spain, United States of American, Wurtemburg.

The representative of the United States was Dr. H. M. Smith of Washington, whose name also appears in the list of vice-presidents.

Fishculture in France.

France has been styled, with some show of reason, the "birthplace of fishculture," meaning by this, of the artificial fishculture which is now applied to the salmonidae, and to a more limited extent to some other families of fishes. Though the possibility of artificially impregnating fishes' eggs and allowing them to hatch under human care was discovered in Germany at an earlier date, it seems to have been two French fishermen, Gehin and Remy, who first, early in the last century, perceived the possibility of employing the process for the benefit of the fisheries, and undertook to apply their theories by actually hatching fish and turning them out in open waters; and when one thinks of the beginning of apparatus for fish-hatching the name that comes first and most prominently to his mind is that of Coste, French professor who devised the apparatus known by his name.

France has not maintained her lead in this field, tho the natural conditions are in some respects unusally favorable. To state the present condition as it is viewed by one of her eminent public men, we may quote the language of Mons. Jules Mercier before the Chamber of Deputies on occasion of the consideration of the question of appropriating money for the use of a hatchery, in December, 1906:

"France is a country of rivers: there is no other nation more richly endowed in this respect. We have 275,000 kilometers (173,000 miles) of rivers, streams, brooks and canals. It would seem that under conditions so favorable we ought to be in position not only to provide for our home consumption, but to export fish to neighboring nations. It is not so however. The fact

is the opposite, and each year we are obliged to buy from abroad seven or eight millions of freshwater fish. Thus we pay a heavy tribute to the stranger,—to Germany, to Belgium, to Holland, who are our suppliers. It is a situation that ought to be remedied, as each year our water-courses are getting more barren."

M. Mercier's further remarks illuminate the situation so much that we continue the quotation:

"What are the causes?

"These causes the minister of Agriculture has clearly defined in his remarkable report on the budget of agriculture in 1904, together with the remedies.

"Of these causes, some may be abated, others should be suppressed,—and among the latter we point out especially the depopulation of our water-courses which is practiced with the use of various substances, especially the berries of *Coccus Indicus*.

"It is necessary to regulate and even suppress the use of coccus berries, and to punish with the utmost rigor the public malefactors who employ such and those who use lime and dynamite, which are equally efficient means of destroying the fish of our rivers.

"Further, there is one point on which all the world is in accord;—that is, that to repeople our water-courses it is necessary to resort to artificial reproduction. That is fully understood by the Direction of the Forests. Charged in 1897 with the service of fisheries, it has made the most laudable efforts, and established several stations. Many departments and communes have followed its example. Finally, private initiative has worked wonders: it has founded numerous fishery societies. Of these societies, which numbered 150 in 1898, there are today 600.

"But all these stations, whether public or private, are wanting in the essential for success,—they lack brood fish. They are obliged to obtain abroad, especially from German sources, from stations in Baden, Saxony and Wurtemberg, the millions of eggs that they handle. What we need is a grand station of fisheulture which can furnish gratuitously to our fishery societies and the other stations belonging to the state, to the departments and to the towns all the eggs that they are now obliged to get in Germany.

"We had constructed the station of Bouzey, but Bouzey has

disappeared by the bursting of the reservoir of the canal of the East.

"The station of Thonon, for which we ask a subsidy of 20,000 francs, has given remarkable results. The minister of Agriculture was pleased to visit it two years ago, and he noted its importance and the excellence of its management.

"This establishment, with a modest appropriation of 3,000 francs, now produces five to six millions of fry, which it distributes in the neighboring departments. It thus supplies excellent products to all this region, seven or eight departments. It further furnishes to other stations of the state and to the hatcheries of towns and fishery societies seven or eight hundred thousand eggs in the best condition.

"The grant of 20,000 francs which we ask for is a pretty small sum in comparison with results that we can achieve.

"The station of Thonon is situated on the shores of Lake Leman, that is, of a reservoir of 58,000 hectares (224 square miles) abounding in fish. It can develop itself without expense on lands which belong to the state. Finally it possesses springs of marvellous purity.

"Today we are allowing ourselves to be outdone by other nations. Thus, alongside of us Switzerland, a country one-tenth of our size, puts into its budget an appropriation of 25,000 francs for fisheulture; and all the cantons of Switzerland vote special subsidies for the same object:—the canton of Zurich, 6,000 francs; the canton of Vaud, 5,000 francs, etc. Other nations give us an example still more striking. In the United States two millions (francs) are appropriated for fisheulture; in Japan, one million; in England and Germany large sums are devoted to this object. In the latter countries the work of fisheulture is carried on by the fishery societies by means of the large grants that are accorded them."

The discussion following these remarks (which are not given in full) was participated in by several members of the chamber of deputies and by the minister of Agriculture. Amongst other facts brought out were the following: there are three principal fisheultural stations, that of Nancy, that of Thonon and that of the University of Toulouse. At these stations they produce solmonoids, cyprinoids and crawfish. It seemed to be the general

opinion that the disappearance or decrease of fish in the rivers of France was due mainly to the pollution of the waters by industrial refuse, but that there was hope of a remedy.

The Minister of Agriculture summed the matter up in these words. "As concerns existing manufactures, the interministerial commission of fish and the commission of scientific studies appointed in connection with the hydraulic service is engaged in researches as to the best means of regulation and of purifying residuary waters turned into the water-courses. Thanks to the work of eminent savants, we shall soon reach this point of finding out easy processes of purifying sewerage and industrial waters, and the day when scientific methods will permit us, we shall do away with that constant source of contamination. It is a matter of national concern to put a stop to the turning of industrial waters into our rivers, not only on account of the disappearance of fish, but beyond that and above all, on account of the public health."

The appropriation of 20,000 francs was voted by the chamber, but with the condition that it should be divided among the three establishments: at Nancy, at Thonon and at Toulouse.

Altho the river fisheries of France are at a low ebb in comparison with their former condition of productiveness, they are by no means exhausted. Even of salmon, those rivers discharging into the North Sea and the Atlantic, which drain nearly nine-tenths of the area of the country, and which alone were naturally frequented by salmon, are still annually producing, we are told, salmon valued at about a quarter of a million of dollars, —a large sum, but, it is claimed by some writers, little more than a twentieth part of what those rivers are capable of yielding.

Besides the three fishcultural establishments named above, there are 68 others belonging to municipalities and 58 to private parties. Among the former may be counted the aquarium of the Trocadero in Paris, which has done as a side-issue a good deal of fishcultural work, with the following species: California salmon, carp, tench, guene, roach, bream, eels, pike, gudgeon, bitterling, stickleback; some of these being of course propagated only for ornamental purposes, but a great many fish were placed in open waters for eventual food purposes. An idea of the species cultivated by other parties may be obtained from the

advertising pages of Le Pecheur, which, during the first six months of 1907 contained the advertisements of six establishments located in France offering eggs or fish for sale and specifying as follows: European brook trout, rainbow trout, and American brook trout are each specified by three parties: carp, tench, roach, chub *(Idus melanotus)*, perch, catfish *(Ameiurus nebulosus)* and calico bass, each by two parties: Scotch trout, steelheads, salmon-trout, lake trout, loach, gudgeon, pike and pike-perch, each by one party. It is interesting to note the position of the five American species included in this list. All these stations supply either eggs or young fish, or both, for planting in open waters.

Of institutions for the rearing of fish to be sold directly to the food-markets and consumers there is, so far as our information goes, but one in France, located near Paris: this is the subject of a sketch below, drawn from the personal observations of a member of the Committee on Foreign Relations.

Fish Cultural Observations in France.

(By John W. Titcomb.)

While in Paris I visited the Aquarium to learn what I could from the director who could not talk English. The Aquarium is very poorly supported financially, and the director is unable to do very much in the way of progressive work. The water supply is from the Seine, and also from the Avre. The latter furnishes cold water for trout. The director claimed that he had kept brook trout in the Aquarium for six months in a water temperature of from 26 to 27 degrees centigrade (79 to 81 degr. Fahrenheit). This I claimed was impossible, and in conversation with a fish culturist, after talking with the director, he claimed that the information which I obtained was unreliable. In the Aquarium were some hybrids, a cross between the lacustras and Loch Leven trout. The fish were two years old and weighed 700 grams (1½ lb.). There were a number of fine Quinnat salmon of various ages and the director informed me that he had obtained eggs from four-year old Quinnats when they weighed two kilos (4½ lbs.) each, and successfully reared the product of such eggs for making up his exhibits. He was under

the impression that rainbow trout required a lower temperature than the speckled trout. When it is necessary to aerate the water he pumps air of a high temperature into the cold water. I merely raised the question about aeration because it occurred to me that possibly some of the trouble from aerated water occurred from pumping hot air into cold water.

After visiting the Aquarium I hired an automobile with the intention of visiting a commercial trout hatchery, said to be the only one in France, situated near Cernay la Ville. The owner of this hatchery is H. Callier. The automobile broke down however, and wore on my nerves and I returned to Paris without seeing the hatchery. I talked with the owner, however, who gave me the following information. Besides selling more or less fry and fingerlings, he produced for market 100,000 trout per year on a water supply of 100 liters (26 gallons) per second. These trout when sold weighed from one-fourth to one-third lb. His pond system covered a water area of 15,000 square meters (near 4 acres), divided into 54 ponds. The fish were fed on an inferior species of sea fish and horse meat, and at the time of my contemplated visit he was feeding about 180 kilos (400 lbs.) per day of this kind of food in equal proportions. The food cost him about 12 francs per 100 kilos (about 1 cent per lb.). The highest water temperature during the summer for one month ranges at about 22 dgr. centigrade (71½ F.). He sorts his fish and cleans his pond three times a year. The young fish he feeds with liver once or twice a day. He claims he starts with 300,000 eggs in order to make 100,000 marketable fish. In other words he raises to marketable size from eggs 33 1-3 percent. The head reservoir which is the source of water supply for all of the ponds contains 800,000 square meters (200 acres) of water. Most all of these ponds are long and narrow, the longest one being 55 meters (180 feet). When transporting live fish, he places two kilos (4½ lbs.) of fish in 60 kilos (132 lbs.) of water in the summer time, and in cold weather for ordinary distances, 4 kilos (9 lbs.) of fish to 60 kilos (132 lbs.) of water. The market price of trout thus raised averages about the same as it does in this country, namely, 50 c. per pound, which in comparison with the low rates of food stuffs in France really is much higher than the market price here. He confines his work entirely to the pro-

pagation of rainbow trout, claiming that his water is not cold enough to successfully rear speckled trout.

The Salmon Question in France.

(From the London Field, Dec. 30, 1905.)

In old times salmon were plentiful in Normandy, Brittany, in all the streams of the basins of the Loire, Gironde, Adour, except, strange to say, in the Rhone and its tributaries, where the fish, so far as historical record goes, seems never to have existed. So late as the end of the fifteenth century salmon was sold daily in the markets, fresh as well as smoked, and up to the end of the eighteenth French laborers stipulated (just as, it has been shown, apprentices in England did) that is should not be given them for their dinner more than thrice a week.

Unfortunately, these halcyon days are long gone by, and it would be difficult to imagine anything more desperate than the present destitution of these waters, which were formerly so rich. Their decline is, no doubt, in part to be attributed to many of the same causes that operate in the United Kingdom, and among them may be mentioned the increase of the population, the development of communications, and the progress of agriculture and industry. There are, however, two other causes, special to France only—the Inscription Maritime and the indifference or neglect of Government and public powers.

The Inscription Maritime is nothing more or less than the national reserve of France for its combative and merchant navy. It was established by Colbert in the time of Louis XIV, in order to supply the fleets of his country with an adequate number of sailors, and as the population of the coasts was not sufficient, then, for the purpose, the astute minister conceived the idea of adding a number of fresh-water fishermen to the regular seamen of the littoral, men who lived not only on the estuaries, but also on the banks of the rivers themselves, sometimes even a very long distance inland. The system has been carefully maintained and kept working ever since, especially under Napoleon I, and though there is at present so great a surplus of "inscrits" that about 60,000 of them are never wanted, there is no likelihood that the Government will ever think of suppressing or changing the meas-

ure. As every inscrit has a right to fish, with net and coble, without paying any fee, and as there are, in fact, scarcely any limitations to this privilege, one may well imagine the results. The Normandy salmon, formerly so abundant, are nearly extinct. In Brittany, where up to a hundred years ago they still were more than abundant, there are now few rivers in which the fish is still to be found. In the Gironde and its tributaries salmon are now a rarity, while in the district of the Loire itself (the area of whose basin amounts to no less than 8000 English miles) the yield has fallen in the last fifteen years to such an extent that the proportion now is but one to twenty then.

The French Government, no doubt, is largely responsible for this state of things. Before 1897 inland fisheries were under supervision and control of the Ponts et Chaussees Department. After that date they passed into the hands of the Department of Forests. On the whole, one may say, the change did not prove altogether successful. To the foresters, just as to the engineers, piscatorial matters remain a secondary part of their business, and therefore receive from them little or no attention. And experts say that so long as a special fisheries department is not created in France, there is not much hope for the better management of rivers.

Politics have also sadly interfered, as usual, in the question. France is the land of universal suffrage, and this suffrage has always had a strong inclination to regard all matters not from the standpoint of general but of private and local interest. And as in fishery matters it is impossible to promote the one without infringing more or less on the other, it follows that Parliament has always shown itself not at all anxious to discuss these matters anew, the more so, perhaps, since the great majority of its members know nothing about them. Amongst the French Radicals, also, there has been, and there is still, a strong prejudice against shooting and fishing rights, which are considered more or less as remnants of the feudal system. For these reasons the fishery question has played a very small part in the preoccupations of both chambers since 1829, in which year was promulgated the law that is still the basis of fishing and angling regulations in France.

Some change, however, has been of late happily noticeable

in the situation, owing to the pressure of a few enterprising people, who are better aware of the disastrous consequences of the state of things prevailing on the rivers. For some six or seven years a movement has been started that is daily gaining ground, and that has begun to tell on public opinion. In England, there is no doubt, the better preservation of salmon has been due in great measure to the presence and to the efforts of a mighty body of salmon anglers. France, however, has never been able to rely on any such assistance. Salmon angling is, in fact, so little known in France, or practised in so very few places, that it interests practically only a small minority. Up to the last two or three decades, angling was not much in honor amongst French gentry, who preferred the gun and the whip, and left the rod somewhat scornfully to the lower classes. Even they for a long time never dreamed about the possibility of capturing the noble fish by hook and line until the practice was imported into Brittany by British residents, some fifty or sixty years ago. And even there, with a few exceptions, salmon angling has never been carried on except in a sort of pothunting and unsportsmanlike fashion, by people whose sole object was the profit which they could derive from it, and who were totally unable, by position, short-sightedness, or ignorance, to understand the importance of the salmon question, or to view it on the broad lines on which it ought to be considered. Everywhere else the situation is still worse, salmon fisheries being mostly in the hands of inland netsmen, whose motto was always and is still equivalent to destruction.

The starting of a movement for the preservation of salmon was therefore, in such circumstances, particularly difficult, there being, in fact, but one large corporation interested in the matter, the Inscrits Maritimes of the estuaries. Their mental attitude was no better than that of the netsmen, and their action was always exercised in the most dangerous way. It would take too much space to give here an account of their various and incessant efforts to obtain increased privileges and to get rid, by degrees, of the last few restrictions that afford, nominally, a semblance of protection for the salmon and other migratory species (shads, lampreys, &c.). Suffice it to say that, up to 1899, far from meeting with any counter-party, they were the object of unceas-

ing Governmental favors, several inquiries on the question having been always conducted with a view to giving their claims satisfaction.

It is only since the said year that some resistance has begun to show itself against their ever renewed encroachments. Owing to the initiative of some men of position (among whom may be mentioned M. du Saussay, Conseiller General d'Indre et Loire; M. Herault, President de Chambre a la Cour des Comptes; MM. Audiffred, Gacon, Pauliat, senators; MM. Peronneau, Petitjean, Defumade, members of Parliament; M. de Paulze d'Ivoy, a diplomat formerly attached to the French Embassy in London), the twenty-four Conseils Generaux of the Loire basin appointed a committee to inquire into the actual state of inland fisheries in general, and of salmon fisheries in particular, in the said basin, and to promote the adoption by the Government of the different measures that would be recognized as necessary for bettering the said fisheries.

The committee, which numbers no less than sixty-nine members, all of whom are either senators, deputes, or conseillers generaux (something, *mutatis mutandis,* like county councillors), met for the first time in April, 1899, and have held since (an unprecedented record for Parliamentary commissions) some twelve or fourteen sittings, at Poitiers, Tours, and Paris. A very long program has been elaborated, the principal points of which are the following: Suppression of Inscription Maritime on the estuaries and lower reaches; suppression of fixed engines; addition of private members to the already existing formal Commission de la Peche fluviale, in the Department of Agriculture; concentration of all fishery matters for the twenty-four departments of the Loire into the hands of a special Government commissioner; removal of all obstacles to the ascent of fish towards the upper waters; and the putting up of fish passes, &c.

At first the commission met with the Government's best will; MM. Mougeot and Ruau especially (the present and the former Ministres de l'Agriculture) had no words gracious enough to emphasize its merits. It did obtain some important results. A stop was put to the excesses of Inscription Maritime; sundry abuses were reformed on several important wiers on the Vienne and the Creuce, and an inquiry was ordered for the enforcement

of the law of 1869 concerning free passage. But as soon as the agitators insisted on a further application of their other resolutions they were then secretly opposed by all the combined forces and by the traditional red tape of the Agricultural Department. The department greatly resented their initiative, was horrified by their audacity and nearly lost its temper at the possible necessity of having to awake out of its pleasant inactivity. Therefore, instead of facilitating the committee's work, the department employed every device that might wear out its energy or discourage its efforts. The committee's case, however, is fortunately so good, and its members are so strong, as to exclude the possibility of a final check. Public attention has at last been aroused, and is not likely to permit so important a question to be shelved any longer. There can, in fact, be no doubt that in due time the committee will get the best of this strange and unexpected conflict, to the great advantage of the Loire and the welfare of the district, for which the salmon fisheries represent a considerable interest, if it is true, as the committee thinks and asserts, that the annual produce of salmon, which for the Loire basin only amounts still to some £50,000 or £60,000, ($243,500 or $267,850) could be easily advanced to £1,000,000 ($4,870,000) yearly.

Fish Cultural Progress in Argentina.

Our enterprising sister republic at the extreme southern end of the western hemisphere has reason to be gratified at the results of the recent introduction of American fish and fish culturists, of which the Society has been duly informed. On the occasion of the visit of Mr. Root, Secretary of State, to South America last winter, he was given a banquet in Buenos Aires at which American brook trout were served. These had been hatched from eggs sent from this country in 1903, as already noted in the Proceedings of the Society.

Mr. E. A. Tulian, national fish culturist, writes that trout commenced spawning a month earlier in 1907 than in 1906, the first eggs being collected on April 27. June 10 he had collected over 200,000 brook trout eggs, nearly all from pond fish, as there were no suitable nets to catch the wild trout from the streams. Within a day or two after the date of his letter, it was expected

140,000 eyed eggs would leave the lake for Buenos Aires, whence they were to be taken to La Cumbre and hatched in a temporary plant erected at that point.

Mr. J. A. Jones, of Nahuel Huapi, tells Mr. Tulian that during the past few months he has personally caught with hook and line about 200 nice brook trout from the little stream which runs through the field near his house, and says they are the finest he ever tasted; he also states that his small boys, who had put a gunny sack across a narrow part of this stream, went upstream and drove 23 nice trout into the sack. A short time ago one of Mr. Tulian's men found an 8-inch lake trout on the shore of Lake Corrintosa, and Mr. Tulian says there is every proof that many of the lakes in the Nahuel Huapi region contain brook and lake trout as well as landlocked salmon.

American Fishes in New Zealand.

Members of the Society are aware of the long continued efforts of the people of New Zealand to introduce American fishes into that colony, and the success attending the transplanting of the catfish and the rainbow trout. The local government has been particularly desirous of acclimatizing our salmon and whitefish, and has received from the United States government many consignments of eggs, most of which were taken on their long journey by Mr. G. H. Lambson, of our Society, and Mr. L. F. Ayson, the New Zealand fish commissioner, who is one of our corresponding members. Under date of May 30, 1907, Mr. Ayson has written us as follows in regard to recent developments, which are of a decidedly interesting nature:

You will be pleased to hear that we have had a run of both chinook and sockeye salmon up spawning this season. You are probably aware that we had a run of spawning chinook salmon in the Waitaki river and its tributaries last season. We discovered them early in May and with the exception of one female fish all the others we were able to capture were spent fish. I am of the opinion that they went up in March and April. This season at the same time we find quite a good run of them again.

The only sockeye eggs imported into the colony were brought over by Mr. Lambson in 1902. Most of the fry which were

hatched out from these eggs were planted in streams which come down from the snowy Southern Alp Mountains and flow into the head of Lake Ohau. Three years after planting reports came down from the manager of a sheep ranch in that territory that a school of fish were spawning in April, and quite a number of dead fish were about. We were, however, unable to obtain a specimen and verify the report. About the middle of April this season fish made their appearance again. The same man went out to the nearest telegraph station and wired to me that a large school of fish were up, that quite a lot of dead fish were about, and that he had 14 caught and enclosed in a pool. I at once sent the manager of the Hakataramea government salmon station up, and he found quite a lot of fish about—a good many dead, and all the others which he handled were spawned fish. They were sockeye salmon all right, and fish running from 3½ to 6½ pounds in weight. Our manager brought 6 specimens down for identification and they stood the test, Sir James Hector and other authorities pronouncing them to be sockeye salmon. These fish are the progeny of the fish planted in 1902, and we may take it for granted that they are estableshed in our waters.

Lake Ohau is one of the branches of the Waitaki River and, as I have indicated in this letter, it is fed by rivers which come down from the snowy mountains.

With regard to whitefish, next summer I purpose netting the two lakes which we have been trying to stock with them. I feel pretty confident that we will take some good whitefish in the nets.

Fish Culture in Japan.

The Bureau of Fisheries received through diplomatic channels a request for a consignment of rainbow trout eggs for the imperial preserves at Nikko, Japan. The eggs, 87,500 in number, were supplied from the Leadville station and shipt in June, 1907, from Seattle to Yokohama.

The most important branch of fish culture conducted under government auspices in Japan is salmon hatching. The hatcheries are in northern Japan, and the work is addrest chiefly to the dog salmon *(O. keta)*, the most abundant species, the catch of which amounts to about 3,000,000 fish annually. Until a few

years ago, the catch had remained about the same since 1892, exhibiting a slight decrease. Recently, however, the output has been increasing, and this is attributed to artificial propagation There are now 28 salmon hatcheries, which liberate 35 to 40 million fry annually. In the opinion of Dr. T. Kitahara, of the Imperial Fisheries Bureau, who in the fall of 1906 made a special inspection of the salmon hatcheries and fisheries, artificial propagation is a least ten times as effective as natural propagation in the case of the dog salmon in Japan.

The Feeding of Salmonoids.

(Extracted from a series of editorial papers published in the Allgemeine Fischerei-Zeitung in 1906-7, under the title, "First Introduction to Feeding of Salmonoids."

Live Food for Fry.

The feeding of the fry is the most difficult task that the fish-culturist has to master. In this work we are confronted by the same dangers with which we have to contend in the nourishment of our own sucklings, which, as is well known, when other foods are substituted for mother's milk, die in multitudes, of intestinal catarrh or other diseases. If we are going to make use of our experience in the feeding of infants, then we must demand:

First, that the food shall be administered always and only in irreproachably fresh condition; *second,* that the food shall be given only in an easily-digestible form; *third,* that the chemical composition of the food shall meet all the numerous demands for the building up of its blood and various tissues.

Beyond question, live food meets all the above demands. In nature the young salmonoid fry feed on microscopic animals, such as insect larvae, that is, larvae of ephemerids, of caddisflies, of mayflies, the larvae of certain gnats, for example the kriebelgnat, also on small crustacea, especially young amphipods ("Flohkrebschen," doubtless meant to include Gammarus and other amphipods) and other minute creatures, which are found on the plants in trout-brooks, between stones on the bottom and on the shore.

Were we in position to furnish the young fry a sufficient

supply of this natural food, the problem of fry-feeding would be solved. But in spite of all the numerous attempts which have thus far been made to breed natural food in an artificial way in considerable quantities, no one has yet got to the point of having this food in sufficient quantity available at all times. Still, this food plays such an important part in fry-feeding that we must speak of the methods of its production.

For the feeding of salmonoids, without doubt the artificial culture of amphipods *(Gammarus &c.)* stands at the head. For of all living food-animals that are to be considered for trout and their relatives, the amphipods are least dependent in their reproduction on temperature, and can therefore be bred in winter or in the cold spring months.

The common amphipod (Gammarus pulex is doubtless meant) has, as an inhabitant of cool trout-brooks, become so adapted to low water-temperatures that it reproduces at all seasons of the year To propagate them on a large scale the best way is to lay out small ditches not over one meter (39 inches) wide and 20 to 30 centimeters (8 to 12 inches) deep, with pools a meter square here and there, say every 5 meters (15 ft.) These ditches are to be thickly planted with water-cress and have a strong current of water passing thru them.

Amphipods are fond of flesh-offal. So, small morsels of finely cut slaughter-house offal are thrown into the ditches, with care against excess, since any considerable development of putrescence must be avoided. The amphipods of the trout-brooks have great appetites for oxygen and do not well stand water that is polluted by putrescence and poor in oxygen.

These ditches are stockt with amphipods from a trout-brook where they have been collected with a dipnet. Here, after a while they will multiply so enormously that a great deal of fry-food can be taken out. Of course, for the fry only the very smallest young amphipods can be used. So the contents of the net with which they have been dipt from the ditches must be strained thru a wire strainer thru whose meshes only the young amphipods, the size of one millemeter (1-25 inch), can pass if they are to be fed to the youngest fry.

With the growth of the fry one can, conformably with nature, also feed the somewhat older and larger specimens, while the

full-grown amphipods are better fitted for the fingerlings and yearlings.

There are establishments that have engaged in this kind of amphipod culture on a large scale and feed all their fry and even their yearlings exclusively on amphipods. Wherever, in the neighborhood of a hatchery there are natural ditches with currents of cool water, there are usually, under natural conditions, so many amphipods that it pays to search them well as the trout-brooks, for food for fry.

However, the construction of such breeding-ditches is not everywhere practicable, and the hunting up and the straining are time-consuming and fussy operations. Much as amphipod culture is to be recommended, however, one will, alas, generally fail of success for the reasons named.

Really more dependent on external conditions than amphipod-culture is the breeding of daphnids and copepods, those minute, almost microscopic crustacea which in point of size would be especially fitted for consumption by young fry. These creatures occur naturally in trout-brooks only in small numbers, since they in general demand a higher temperature. They are plenty in our waters only during the warm season of the year and they reproduce abundantly only at that season, passing the cold winter months mostly in a state of rest.

The only exceptions to this rule are in the cases of large, deep lakes that do not freeze over in winter, where the species named are to be found the whole year thru; altho, even here, they occur very sparingly in winter. Whoever is fortunate enough to live in the vicinity of such lakes can at any time get these animals for fry-food, by fishing with a fine gauze net. The best time is in the twilight, say about an hour after sunset; for the crustacea mentioned have the habit of collecting in swarms at the surface of the water at nightfall, whilst during the daytime they scatter in the depths. Catches made in the twilight are therefore far better. In lakes that freeze over in winter one can count on a good catch only from May on, that is, when it is for the most part too late for the rearing of fry.

The artificial culture of daphnids and copepods has been often practiced. The process consists in laying out small ponds of about 2 square meters, (22 square feet) and one-half or two-

thirds of a meter (20 to 26 inches) in depth, strewing the manure of various animals on the bottom, spreading a hand-depth of garden earth over this and with a gauze net transferring to this pond the mother crustacea from any pool or pond. From the manure many protozoa are developed, also unicellular algae, which serve the crustacea for food, and when the water in the ditches is well warmed up, say up to 20 degrees, and higher (77 Fahrenheit and upward) the development of the crustacea may become so rapid that in a few weeks the water of the ditches straightway swarms as with a living soup, and affords a rich booty.

But, as already noted, the rate of reproduction of these animals depends so much on the temperature that it is not possible to get daphnids in this way in great quantities so early as February or March. It has therefore been recommended instead of ditches in the ground to use petroleum casks in a similar way and set them up in stables where the temperature is even; but here the yield corresponds with the narrow space in the casks and is a very small one; and the whole process is right fussy. Altogether the culture of daphnids in any method yet devised has not come into general use; and so it will remain in the future, unless some one succeeds in finding daphnids that with good nutrition reproduce rapidly in confined quarters during the cold months.

What we have said about daphnids and copepods applies also to insect-larvae. These also multiply enormously in artificial pools that are drest with manure, but only during the warm months, and in especial abundance only so long as sunny weather prevails. The reason for this is that insects swarm freely and lay their eggs in water only in sunlight, while in cold rainy weather they crawl away.

Artificially bred insect-larvae, among which we have to count fly-maggots, cannot be had in quantities in the early months of the year, when we are in especial need of fry-food. But on the other hand, in the rearing of yearlings of which we shall here speak later, the breeding of maggots plays during the summer months a more important role.

From the foregoing discussion the conclusion is drawn that we can at any rate under favorable conditions in some places

produce amphipods for fish-food at the proper time and in satisfactory quantity. But as to the other food-animals that come into this question, they cannot be had in quantity until it is too late for fry-feeding. Under present conditions therefore we are imperatively referred to artificial food when the problem is to feed a somewhat larger number of fry.

Food for Fingerlings and Yearlings.

Doubtless live food is best, and those establishments which have a specially favorable location, that is, in a region where, on account of the mild climate and fertile soil, natural food exists in large quantities, of which, in particular, insect larvae form a chief part, undoubtedly thrive best when they reject artificial foods and maintain their stock of yearlings on natural food.

This sort of rearing may be much helped by introducing in quantities, living natural food, which, according to the situation, may be collected from brooks or produced in special pools. It is to be especially noted here that for this purpose, the common fresh-water shrimp, (*Gammarus pulex*), may be collected in quantities and introduced into the ponds from small ditches leading from trout brooks and well stocked with water plants. Here, too, these shrimps are able to increase abundantly among the plants, if they find the necessary food, so that if a brood stock of them is once established a succession of them is assured, even when the ponds are more crowded.

Further, the artificial introduction of snails into ponds is of great importance. The fittest for this purpose are the small and middle-sized Limnaeas, which are found in trout brooks in quantities, on plants and on the bottom, and which may be easily gathered with a dip-net and transferred to the ponds. Here they often increase so that they cover the entire bottom. If these are not directly eaten by fish in their first summer or first year (because in mature form they are usually too large) their eggs as well as the young snails furnish an excellent trout food. Then too the snails are an especially good means of disposing of the excrement and food-waste on the bottom of the pond. Snails kept in numbers are desirable for keeping fish ponds clean, as they are also chosen and kept in aquariums for this purpose.

For food for yearlings it is possible to produce in quantities artificially and introduce into the ponds a whole list of other living creatures.

In the first rank stands the artificial production of fly-larvae. These are produced most simply by setting on a stake about 20 inches above the water, a box open on the under side and having a wire-cloth bottom 3 or 4 inches from its lower edge. On this bottom are laid offal, pieces of dead animals or any kind of carrion; the flies are attracted by the smell and come and lay their eggs here, and the larvae, as they develop, fall into the water and are eagerly taken by the fish. In producing maggots in this way care must be used lest on warm days too many develop, while on cold ones, the production may cease altogether. In the first case, if more maggots are produced than the fish can consume, the maggot-yielding meat must be taken out of the box for a while. To lessen the smell nuisance, it is well to have the maggot-box tight, with only small holes to admit the flies.

In rearing yearlings, the artificial production of daphnids and shrimps *(Gammarus)*, which we have already considered, in this paper, plays an important part; for, as the best period of growth for yearlings is in summer, so also, because of the temperature then prevailing, that is the fittest time to acquire a large quantity of daphnids in the ditches where they are produced. In summer, too, the drains and small pools and ponds in the fields generally yield a rich booty of these creatures.

The above-named food creatures, which live and increase in the fish-ponds themselves, are unfortunately not everywhere to be had in sufficient numbers. In particular, many salmon establishments located in wild situations are so poorly supplied with natural food that it is necessary to furnish other food in the ponds. The same necessity exists also in most establishments which undertake the production of large numbers of yearlings in small space, even when the situation would otherwise be favorable,—that is, when the stock is too great for the rich, natural, food supply. In such cases artificial food must be provided. Of the artificial foods to be considered for the rearing of yearlings, are naturally to be mentioned all those which have already been named in connection with fry-rearing; but it must be remarked that spleen, liver and brain, which in themselves would be use-

ful for yearlings, must be omitted on account of their high price, because for yearlings too large quantities are needed. On the other hand, in the front rank and especially to be recommended for feeding yearlings is fresh fish. This is prepared just as already described for fry feeding. Altho fish too commonly reaches a pretty high price, especially in southern Germany, where the transportation of fresh sea-fish during the warm season becomes much more difficult, and where consequently only the cheaper fresh-water fish are available, there is nevertheless no other better food and this is therefore to be placed in the front rank, in spite of increased price.

As a substitute for fresh fish, frog flesh may serve. When it is possible to get frogs in quantities, they are killed, boiled, and, after the removal of the large bones, ground fine, and fed out just like fish. In the same way it may be recommended to collect living land snails of all sorts. If these have shells, the shells must not get into the food, because splinters of shell generally are as sharp as glass, and might injure the intestines of the fish. To remove the shells the snails are thrown into boiling water, where they immediately die, and may then be easily pulled out of the shell.

If it is not possible to have fresh flesh of frogs or snails always ready in sufficient quantity, as unfortunately will often be the case, it is necessary to have recourse either to slaughter-house offal or to dry foods. The slaughter-house offal, that is, the cheap meat not used for human food, such, for instance, as comes off from the plucks and from the hide, is often employed as food for yearlings, and in this way: it is first cooked and then ground fine with a machine and thrown directly to the fish. This food has not, however, been always approved in the rearing of yearlings. It is asserted that from its use serious intestinal diseases appear among the young fish and it seems that this offal is too indigestible for them. It happens that much slaughter-house waste sometimes comes to be fed not entirely fresh, and then severe diarrhea and even a great mortality to the young fish result. The same which has been said of offal applies also to horse meat. This also, like the offal, is, on account of indigestibility, not to be recommended as food for yearlings. Especially is further warning necessary to avoid smoked or salted horse flesh which the young

fish are absolutely unable to bear. Instead of the offal or horse flesh, the dry foods are to be preferred under all circumstances. These, if well and properly prepared, may be employed as a substitute for fresh fish. As to the mode of preparing and feeding them explanation has already been given in connection with fry feeding. We add to that only that among the dry foods the fish-meals are to be ranked first, while, on the other hand, blood-meal which is often considered hard to digest, should be employed less as a food for yearlings than for forcing.

Food for Brood Fish.

It may be stated here as a foundation principle, that brood fish, if they are to produce healthy and strong progeny, must be carefully provided with the best sort of food, with which the fish breeder must be especially careful. It it cannot be doubted that fish grown in free nature and wild waters produce the healthiest offspring, it follows that for brood-fish live natural food is the fittest under all circumstances. He, therefore, who can possibly keep his brood fish in large ponds, in which nature provides the necessary food, does best to omit artificial feeding altogether. There are some fish-breeding stations so favorably situated that the insect world occurs in exceptional numbers in these waters and there lays its eggs, so that the ponds swarm with insect larvae. Here great quantities of brood fish can grow without artificial feeding.

Where nature is not so liberal the breeder may help by introducing into the pond, in quantities, for example, amphipods and snails, which increase there notably and are eagerly taken by the fish. On this subject we have already written more fully under "The Feeding of Yearlings," and also indicated the unfortunately narrow time-limit within which it is possible to secure live food in sufficient quantities.

Unfortunately the majority of pond establishments are not situated under so favorable climatic conditions that they can leave everything to nature. The desire to maintain the most possible brood-fish in a given space and under existing water conditions is entirely justifiable, and the great majority of fish culturists are therefore compelled to maintain and rear even their brood-fish with artificial food.

In such case what foods shall be considered? Fish themselves undoubtedly stand in the front rank, fresh-water fish as well as sea-fish. Where it is possible to obtain cheap fresh-water fish, as for example, lauben, hasel and stromer, (three cyprinoid fishes similar to American chubs, dace and shiners) which on account of their small size, at best can be used for bait and hence in many places, as large lakes and rivers, may be had at 10 to 12 marks per Zentner (¼ cent per pound), it is advisable without doubt to put this food in the front rank.

As a general principle, fresh-water fish must never be fed out living or fresh, but always in the cooked state, because otherwise there is too great danger of introducing a variety of diseases. When fresh-water fish are cooked they usually fall to pieces in the process and may then be thrown direct to the fish as food. Where it is not possible to obtain fresh-water fish in sufficient quantities, or when the price is prohibitory, sea-fish come in, which are carried everywhere, especially from such wholesale fish markets as Geestemuende, Hamburg, and Altona, but which are also to be had in many inland places, since we have already a notable list of prominent sea-fish markets in the interior, from which such things may be transported at a considerable saving of freight charges. All sorts of sea fish may be considered which are too small for human food. In the same way may be used the otherwise worthless heads of the larger fishes. Unfortunately those sea fishes are not to be recommended which are distinguished by being very fat, as especially herring, which are sometimes thrown on the market in great quantities at a very low price, especially near the coast. The fat is very unfavorable to egg production, since in the feeding of brood-fishes, fattening them is to be especially avoided.

When sea-fish are used for food, they also should be offered in the cooked state, in the first place on account of the possible production of parasites, secondly because in feeding heads, the bones must be softened by cooking. In this case, of course, the large bones are to be removed and the small ones, if not cooked up, are to be crusht as well as possible. Sea-fish cost everywhere as much as fresh-water fish, but there is the advantage that they are regularly obtainable and in the desired quanti-

ties. Unfortunately, stations further from the sea are at a disadvantage, because the transportation of sea-fish involves large expense, and because during the warm season, that is, the summer, the fish can only be sent packed in so much ice, that freight charges are too high. But it is impossible to insist too strongly that sea-fish must not be fed out, which are not quite fresh or which betray by their odor the beginning or advancement of decomposition. For it may be counted on with certainty that intestinal inflammations and great loss will follow the use of spoiled sea-fish, and moreover, there is sufficient reason to suspect that by the use of any sort of food which is not fresh, the production of sound eggs and milt is made doubtful. Perhaps the frequently noted degeneration of eggs and milt is to be attributed principally to such not quite fresh foods. Thus even feeding with sea-fish has its limitations, as will be seen, and it must moreover be admitted with regret, that for the feeding of brood-fish we have at present no food material which is in all respects satisfactory and unobjectionable. For if fresh and salt-water fish cannot be used, there remain as a resource only either the dry foods, that is, fish-meal, meat-meal and blood-meal, or the slaughter-house wastes, which however, as will be seen later, in the consideration of feeding for market, all have their faults and deficiencies.

For the feeding of brood-fish snails are occasionally to be considered, that is, vineyard snails, naked snails of all sorts, such as are found in damp woods, and of course, water snails. These are all to be cooked and thrown to the fish without further preparation. If they have shells, they must first be pulled out, which is easily done after cooking; or they should be pounded up fine, shell and all.

Frog meat is also good to use as food for brood-fish. All these and similar foods are, however, unfortunately, to be had only occasionally in sufficient quantity, and play no great role practically.

We see then that foods for brood-fishes are very limited, and mention that many breeders have altogether abandoned the feeding of brood-fish and employ only wild fish for procuring eggs and milt. For European brook trout this position is undoubtedly the right one, and it would be for the rain-

bow trout and American brook trout also, if enough wild fish could be had, to meet the demand for eggs and fry, as well as yearlings of these sorts. Since this is, unfortunately, not the case, all who breed these sorts will be driven to feed brood-fish.

Forcing.

Under this heading may be here understood, not only the feeding by which the fish are driven rapidly, and beyond the usual limits of growth, but also the feeding of fish intended for market. Since this latter has to do with the production of so-called mess-fish, (portionsfisch) that is, fish of an average weight of 100 grams (3½ ounces), the question arises, what food is specially adapted for this purpose?

Here naturally again stand in the front rank the fresh and salt-water fish, which have been already recognized as the best food for brood-fish and for the earlier stages. This food should not be lacking in any forcing establishment when it can possibly be obtained.

Unfortunately there are many establishments which cannot obtain fresh-water fish at a satisfactory price, and the transportation of salt-water fish also naturally ceases in the heat of summer for all such establishments as are remote from the sea; thus nothing is left for fish-forcing but recourse to two foods, —that is, first, slaughter-house waste, and second, the dry foods, that is, fish-meal, meat-meal and blood-meal.

Slaughter-house waste is a food which can be obtained everywhere and always fresh. It comes everywhere at a price not higher than one or two cents a pound, delivered at the station, and five or six pounds of it is required to produce a pound of fish. Slaughter-house waste must be used only scalded, and for this reason, that the digestibility of it is thereby materially increased. Great emphasis is to be laid upon this, because slaughter-house waste is of itself always hard to digest, and makes the greatest demands on the digestive apparatus of the fish. Everything must therefore be done, to do away with this indigestibility as far as possible.

A second precept is that slaughter-house waste, after cooking, must be made as fine as possible; the finer it is, the easier it is to digest. Throwing it into the ponds in large pieces is to

be carefully avoided. From this arise, among the fish, the so dreaded internal inflammations by which many thousands of fish are annually lost.

A third rule is, that from the offal all sinewy parts are to be removed, because these cannot be digested by the fish. The fine chopping which the offal requires in order to be digestible, has one evil result. Namely, when such fine food is thrown into the ponds, it scatters so that much goes to waste and decays on the bottom; in consequence of which the ponds are badly fouled. This disadvantage must be counteracted by all means. The next thing to be recommended is to bind the chopped food together by the addition of rye flour. The proceedure is, to add to the meat about a fifth of its weight of flour, and to cook flour and meat together to a pudding, which, after the cooking, is placed on ice for the purpose of cooling and hardening. Of this pudding, pieces of the size of nuts and smaller, are easily made, which, when thrown into the water, are not immediately washed apart into their smallest bits so as to foul the bottom of the pond.

The second means of preventing the infection of the ponds, is a current of water, as strong as possible. The principle may be laid down that fish-forcing should be carried on only in ponds in which a large water supply is available. The flow should always be at least so great that the water in the pond renews itself in twenty-four hours. Of course in such ponds it is indicated not to draw off the surface water, but rather, by means of a double penstock, (moench), to let the water off from the bottom, so that the waste material from the food and fish-excrement which lies on the bottom may be carried off.

It is plain that slaughter-house waste should always be used entirely fresh, since, as soon as it has begun to spoil, there certainly appear inflammations of the alimentary canal, and consequent heavy losses of fish.

Besides slaughter-house waste, horse-flesh is occasionally used for fish-forcing. The preparation of this follows the same course as has just been described for offal. In the use of horse-flesh, however, great care should be taken, because horse-flesh does not give the fish a good flavor. In consequence of this, the good reputation of an establishment may be seriously injured.

The fish acquires a sweetish taste, with a soft, mushy consistence, and a color running somewhat into green. He who wishes to use horse-flesh, therefore, must do it only occasionally, and in any case, not toward the end of the feeding. For some weeks before their sale the fish must always be fed exclusively with the very best food, in order that the flavor may be the best possible.

Attention should still be drawn to an excellent food for forcing. This is the viscera of fowls, which, especially in the neighborhood of great cities with large poultry markets, may be had in quantities at a very low price. These entrails are very easily digested by the fish, which grow exceptionally fast when fed with them. It should be noted, however, that with these viscera the chicken cholera is usually introduced into the pond system, so that in such establishments and their neighborhood poultry breeding is no longer possible.

Where there is difficulty in obtaining fresh slaughter-house waste at above named prices, nothing finally remains but to use the dry foods, fish-meal, meat-meal and blood-meal. Instead of blood-meal, blood itself may be used, if it can be put in the right form. The blood should not be fed directly in the liquid or coagulated state, because it dissolves too much in the water and causes serious defilement of the ponds. Fresh blood should rather be mixed in advance with about one fourth of its weight of rye flour. The whole mass is then heated in a kettle until it just begins to boil. Hard cooking is to be avoided. After the heating, the pudding just produced is poured out on boards in layers of the thickness of the finger, when it immediately stiffens and may be kept several days. Before feeding, the blood-pudding is put through the meat machine, and formed into small sausage-shaped pieces which may then be thrown directly to the fish.

Blood-meal, too, should not be fed directly, but must likewise be bound together by the addition of rye flour brought into a sticky condition. This is accomplished just as when fresh blood is used; only of course water must be added to make a stiff pudding.

Fish-meal, just like blood-meal, must be fed in the form of a sticky pudding, because otherwise and in any other way, too much of it goes to waste, and decays on the pond bottom. For

this purpose the fish-meal is best mixed with about a quarter part of rye flour, and by the addition of water, cooked up to a stiff pudding which, after cooking, is fed direct. If an ice-cellar is available, it is recommended to put the pudding first on the ice, so that it may become firm. The proceeding with meat-meal is the same as with fish-meal. Only it is to be observed that in this case, when cooked to a pudding with rye flour, the meat-meal should receive the addition of one to two per cent food-lime, (Futter-kalk), because the meat-meal contains too little of the lime salts, which the fish need for making bones. Instead of the lime, fish-meal may be added, if the fish-meal was made of entire fish; in this case it contains enough lime from the bones of the fish. A mixture to be recommended, would then consist of one third fish-meal, one third flesh-meal and one third rye flour, to be cooked to a pudding with the addition of water. Since vegetable meal is less easily digested by trout than meat-meal, it is advisable to use a quarter rye flour instead of a third.

With these foods must fish-forcing everywhere reckon, in practice. What may occasionally offer in the way of waste material, is not generally of great importance.

Utilization of Earthworms as Food for Trout.

(From l'Acclimation, 15 Dec. 1904.)

Earthworms play a pretty large part in the natural feeding of trout, as of almost all other fish, for which these annelids furnish a well-relished food and one which seems to be especially wholesome. In the aquarium at the universal exposition at Anvers in 1894, where were assembled specimens of most of the fresh water fishes of Belgium, the new departure was made of feeding only earthworms to all the varieties thus placed on exhibition, and to this precaution are attributed the fine appearance and perfect health of these fishes, which escaped the sickness and large death rate which are usually severe in the case of fishes transferred widely from free streams to the narrow and necessarily less wholesome quarters of such an aquarium.

For a long time now fishculturists have dreamed of utilizing

as food for occupants of vivaria the earthworms which are everywhere found in great abundance in moist soils. Darwin estimated the number of worms existing in a hectare (2 1-2 acres) at more than 130,000, weighing about 115 kilos, equivalent to about 52,000 worms, or 100 pounds per acre.

It is possible to collect these worms in quantities in the fields at the time of tillage, immediately behind the plow which has uncovered them, and this is what certain growers have done in order to secure living animal food for their aviaries or poultry yards. Since this proceeding was always dependent on the plowing, it has been found necessary to try to find a more practical means of obtaining worms in sufficient quantities. Different systems have been occasionally suggested, but thus far no method has been found giving uniformly satisfactory results. Last summer a very distinguished agriculturist, the Baron Malsen, proprietor of the large establishment of fisheulture at Karlstein, near Bad-Reichenhall, Upper Bavaria, attempted a very interesting experiment in the artificial cultivation of worms, with a view to procuring them for food for his trout. The method which he followed was suggested by Prof. Roules of the Faculty of Science, of Toulouse. This was the procedure:

A long trench, about 50 centimeters (20 inches) deep and of about the same width, was dug in the ground; then by means of old discarded boards this trench was divided into compartments of equal size. One of these was left empty and the next two were filled with compost mixed with rotten wood and the materials were heaped up to form a mound as high as the depth of the ditch. The full compartments which alternated with the empty ones were covered with rotten straw and dry leaves loaded with large stones to keep them from being blown away. After a sufficient time to permit the multiplication of the worms, with which they had been previously stocked, the heaps were broken up, to permit the collection of the worms, and in their turn the compartments previously empty were filled with the materials of the demolished heaps, new ones being thus formed, and so on in succession.

Contrary to the usual belief, experience proves that angleworms in order to multiply considerably do not need a great deal of moisture, which would even be unfavorable. Compost made

of swamp soil does not suit them, and in a moist climate like that where this experiment was tried it even seems unnecessary to water the compost heaps, although this would doubtless be useful in dry regions. But the covering of leaves is indispensable, as above described, for a protection from the sun. It may be added that watering with manure-water or urine seems to be favorable to the production of worms.

For nutritive qualities the worms thus obtained seemed superior to horseflesh, butcher's waste, offals, dried blood, etc., commonly used by fishculturists as food for trout, and they seem equal to the coarse fish now used in England for this purpose in many fishcultural establishments.

The collection of the worms requires the alternate demolition of the compost heaps, which means considerable work. Therefore where wages are high, as is the case in upper Bavaria, the production of angleworms although practicable is found to involve an expense relatively worth considering, especially when it is admitted that the return could never be very great. In an establishment of the importance of that at Karlstein, for instance, when the annual consumption of food exceeds 20,000 kilos, earthworms could provide only a relatively small part.

Therefore, even though the result of the trial has not been as complete as it might be, it has not seemed worth while to follow up the production of worms, especially since, thanks to a reduction in railroad rates, the Karlstein establishment can actually procure as trout food coarse fish at a very low price (or about 20 to 25 centimes per kilo) and in quantity which may be called unlimited.

Mr. Malsen nevertheless considers the artificial production of earthworms as food for meat-eating fish worth recommending to a fishculturist who is running a small establishment himself without helpers or laborers, and in a country where course fish cannot be obtained at so low cost as in the region of Bad-Reichenhall. He thinks that gardeners, under-proprietors, farmers, etc., who attempt trout growing on a small scale and aside from their chief occupation, could not find a simpler or more practical means of procuring food cheaply for their fish, than the production of angleworms by the method above described.

The curious fact may be mentioned that Mr. Malsen states

that the labor of finding and collecting the worms may be notably simplified by means of a weak electric current which by help of a wire and a small battery is caused to pass through the worm-filled heaps, especially through their deeper parts. The worms try to escape and come in great numbers to the surface, where the collection becomes easy. It is in this way, finally writes Mr. Malsen, that we should hereafter proceed if we were to undertake the production of angleworms on a large scale, which might happen if, in consequence of an increase in cost of coarse fish by an advance in freight rates, we were forced to seek other food for our trout.

The above report is respectfully submitted by the Committee on Foreign Relations:

Charles G. Atkins.
John W. Titcomb.
Hugh M. Smith,
James A. Henshall,
F. M. Johnson,
H. F. DePuy.

A paper by Mr. Charles G. Atkins of East Orland, Me., on "Manipulation of Salmon Eggs" was then presented.

Dr. E. A. Birge of the University of Wisconsin, delivered an address on "The Respiration of a Lake," and the subject was discussed.

Mr. Meehan: Mr. Chairman, some time ago, in pursuance of my duties as commissioner of fisheries of Pennsylvania, I did something well within the law, but some people did not like it and called it the high-handed outrage of an usurper. I propose just now to act that role of usurper, and for a few minutes at any rate, depose our president from the chair while I offer a resolution and put it.

Resolution read by Mr. Meehan as follows:

Resolved, That the society express its appreciation of and thanks to Dr. Birge, the retiring president, for his uniform courtesy, and the ability with which he presided at the meetings held in Erie.

Gentlemen, you have heard the resolution. (Applause).

Motion made that the resolution be adopted by a rising vote.

Resolution carried unanimously.

Dr. Birge: I thank you, gentlemen, for this kind expression of your confidence in me. When I said last night that I had taken the presidency with a great deal of trepidation, I spoke only the truth. I am very glad the meeting has been so well attended, and that we have had so much material and such lively discussions. I am even glad that the fry vs. fingerlings proposition came up to enliven us, and I must say that I regret the absence of our constant friend of the carp.

Is there any further business to come before us?

Mr. Clark: Mr. President, as there seems to be a little doubt, I would include it in our report that the address be published.

President: If the business of the society is over, I will call Dr. Smith—

Mr. Titcomb: There are some other papers which have not been read.

President: All the papers not read, it will be understood will be printed.

A paper by J. J. Stranahan of Bullochville, Ga., on "Theory vs. Practical Tests," was presented.

A paper by Robert E. Coker of Johns Hopkins University, Baltimore, Md., on "A Study of the Guano Industry and Fisheries of Peru," was also presented.

Secretary: I would say that it would facilitate the business of the treasurer if the members who have not paid their dues would, after adjournment, step up and liquidate; and also that there are a number of reports of the Ontario Fish & Game Protective Association here that will be distributed if the Association wishes any, and I have a number of last year's reports of the Society, and any one who cares for them can have an extra copy.

President: I will ask Mr. Evans and Mr. Clark to escort Dr. Smith to the chair.

Dr. Smith escorted to the chair by Mr. Clark and Mr. Evans, amidst great applause.

Dr. Birge: It gives me great pleasure, Mr. President, to

turn over the Society to you for the most important meeting in its history.

Dr. Smith: I am glad you did not adjourn before giving the president-elect an opportunity to express his thanks for the unsolicited honor you have conferred on him. I assure you he appreciates it, even if he did not deserve it, and that he will labor for the best interests of the Society. If Commissioner Bower were here I should take revenge for the trick he played on me last night in calling on me to make my remarks.

Gentlemen, I bespeak for the Society and for myself and for the other officers for the ensuing term a continuation of your cordial support and coöperation to the end that our Society may be greatly increased in membership; that it may grow in influence, and that it may become a most potent factor both in America and throughout the entire western hemisphere in promoting the interests and controlling the destinies of our common friends, the fishes.

I hope that during the next year your mental gaze will be directed to the goddess of liberty on the national capitol building, and that you will adopt as your slogan, "On to Washington!"

Down in Washington we have no noble lake on which you can keep your eye, and we cannot compete with Erie in other ways, but we have at our door a river rich in historical associations, and we have been blessed by the wealth of our beloved Uncle Samuel with a number of strong cards about which it is perhaps best to say nothing until the game is played.

I thank you very much for this consideration and honor. (Great applause.)

President: Is there further business before the Society? Mr. Meehan, have you something?

Mr. Meehan: I simply move to adjourn, that is all.

President: Is it seconded that we adjourn to meet in Washington in 1908?

Motion seconded.

Motion carried unanimously.

President: We stand adjourned.

PART II.

SCIENTIFIC PROCEEDINGS

THE NECESSITY OF THE STATE MAKING LAWS FOR THE PROTECTION OF FOOD FISHES AFTER STOCKING WATERS BY THE STATE OR UNITED STATES.

BY OREGON MILTON DENNIS.

Secretary Maryland State Game and Fish Protective Association

To the American Fisheries Society assembled at Erie, Pa.

Gentlemen: That there is immediate necessity for the coöperation of the various states to come to the aid of the fish culturists by the passage of proper laws for the protection of food fish after their propagation and distribution in the waters is, I think, admitted by all. The whole scheme of fish protection, primarily, is first to protect the parent fish during the spawning season, and then to protect the young until they arrive at sufficient age and size to be used as food. As is well known, every device that the brain of man can conceive of, has been brought into use to take the largest number of fish, without regard to size, with the least possible expense to the catchers or fisherman.

Various and numerous laws have been enacted to protect the young fish, but the enforcement of these laws is difficult and in many cases, impossible of enforcement. Admitting, then the necessity of the protection of the young fish after having been placed in the waters by the states and the United States, the question that confronts us is how? I believe that if it comes within the constitutional powers of the United States, congress should pass suitable interstate laws for the protection of fish. I have not had time to go into this question, so am not prepared to pass on this. But something has got to be done. In many states the appropriation of money for the propagation of fish is a sheer waste. It seems so strange to me that a legislature which will appropriate money for increasing the fish supply in its waters, still refuses to make an appropriation for their protection. This is so in Maryland at least.

Now as to the remedies:

1st. Laws should be passed in every state placing a size limit on all food fish, prohibiting the catching, having in pos-

session, selling or transporting any fish below a certain size, in other words a cull law should be passed, forcing every catcher of fish to have at the time of taking fish, a culling board, and forcing him to return to the waters immediately all undersize fish.

2nd. Haul seines of every description should be prohibited. In many sections of Maryland, at times, the shores are lined with small fish, ruthlessly and wantonly thrown upon the shore by the seine haulers. I do not believe the stake or floating net does much harm to the small fish.

3rd. Closed season should be regulated by law during the spawning season. The wisdom of this is questioned by many, but I am a firm believer in this method of protection of the parent fish, that it may freely deposit its spawn.

To close, the necessity of protection of the food fish after artificially propagated and placed in the waters is the necessity of proper laws for general fish protection. I believe the states are now awaking, and I hope Maryland will get into the right line at the 1908 session of the Legislature.

DISCUSSION.

Mr. W. E. Meehan: Mr. Chairman, the paper is one of importance. I do not say that I can agree on every point,—the use of the haul seine, for instance, prohibiting such a device. But I do agree that the only solution of the problem is federal control for the enforcement of laws or the creation of laws for the protection of fish. As was stated this morning, when the question of uniform laws on the great lakes was mentioned, it is often difficult to make a uniform closed law, and I question at any rate whether it is advisable to have a closed season, because such laws operate against the artificial propagation of fish. I believe that the solution is in the size of meshes and the size of the fish, and the forbidding of the transportation of undersized fish, either through or out of the state. But, as I said a few moments ago, I believe the real solution is in federal control.

THE SHAD WORK ON THE DELAWARE RIVER IN 1907 AND ITS LESSONS

BY W. E. MEEHAN,

Commissioner of Fisheries of Pennsylvania

There is little that the people living along the line of the Delaware valley are more interested in or guard more jealously than the shad industry in the Delaware River. From the lowermost point of Delaware Bay to the shallows of the river in New York state, the people look forward to and seek with great eagerness the delicious shad as they ascend in the spring to spawn. In comparison with this magnificent food fish any other industry sinks into significance in the minds of the men and women who are within reach of the supply. If any man in his own financial interest talks of constructing a dam, however small, across the river, there is an uproar raised about the matter at once.

If any corporation with plausible declaration that it is chartered for the purpose of benefiting humanity and the convenience of the public, attempts to secure legislation for the purpose of harnessing the river to provide light and power, the newspapers are up in arms at once and the voters along the entire district are out on the warpath among the representatives in the legislature to prevent the passage of any bill which will prevent the free and unobstructed migration of the shad.

The shad industry on the Delaware river has been subject to many interesting and almost wonderful fluctations. It is said that in the early part of the last century the annual catch was worth about $125,000 including the fish which were kept by the farmer fishermen above Trenton for winter use. In those days people came for a distance of fifty or more miles in wagons purchasing or trading goods, especially salt, for shad. About 1860, owing to a rapid growth of population, the drain on the river became very great, especially since all manner of destructive devices were employed for catching of fish. As a consequence before 1880, it is claimed, that the industry had shrunk to a value of only about $80,000 a year.

With the appearance of the United States fish commission and subsequently also by the Pennsylvania fish commission, there was a speedy increase until between 1890 and 1900 there was $200,000 reached. In 1899 and 1900 shad were so abundant in the Delaware river that it was not uncommon during the height of the season for them to be sold in some of the small New Jersey towns as low as $1.50 and $2.00 a hundred. Between 1897 and 1904, Pennsylvania did no shad work on the Delaware river owing to insufficient appropriation. In 1898 the United States fish commission occupied and operated the Pennsylvania fish commission's field station at Bristol for a portion of the season, the Fish Hawk having been taken away for naval purposes by the war department. For two years after the United States government took a very large quantity of eggs from fish in the Delaware river, but immediately after 1900 there was a noticeable decrease and in 1905 when the United States bureau of fisheries operated the state hatchery at Torresdale jointly with Pennsylvania, there were only a little over 3,000,000 eggs taken and most of them from two shore nets, one at Washington Park and one a short distance above Torresdale.

Between 1890 and 1900 the United States could take that many eggs in a single day easily from the Washington Park fishery alone and Pennsylvania could take a like number from four o'clock in the afternoon until nine o'clock from what was known as the Faunce fishery near Riverton. In 1906, last year, the United States bureau of fisheries, if I am correctly informed, took less than 250,000 good eggs from the Washington Park fishery and Pennsylvania only succeeded in getting 3,018,000 good eggs from the shore and gill net fishermen above the Pennsylvania railroad bridge, which crosses the river above Frankford. This year, 1907, the United States bureau of fisheries did not enter the river at all, leaving the entire work in the hands of Pennsylvania.

By hard labor there was taken 5,800,000 good eggs and of this number only 136,000 came from the Washington Park fishery and the bulk were secured from a small shore seine above Torresdale, Philadelphia, known as the Page fishery. The total number was 5,834,000 good eggs. The exact number taken from the Page fishery was 2,065,000. Another fishery owned by a

man named Lovett near Tullytown, yielded 105,000 eggs. The remainder were gathered from gillers, most of whom fertilized the eggs themselves and brought them to the hatchery thus gaining the additional pay per million eggs. The heaviest day's take was 387,000 on June 18, from four nets, one net yielding 154,000, the department of fisheries' own net 100,000, a third net 91,000 and a fourth net 42,000.

There were doubtless a number of eggs lost through the indifference of gillers who operated above Delanco and below Holmesburg. Judging by the take from the gillers between Delanco and Holmesburg about 2,000,000 eggs were thus lost. About 200,000 eggs were sent up from the Bay near Salem, but they were worthless. All the eggs taken were remarkably good until June 19, with few exceptions. In some instances all the eggs were fertilized excepting the ends and the average hatched was a good 90 per cent, with the exception of a few shad that were experimented with by the Department in the hope of augmenting the supply by means described later.

The average period of hatching was seven days throughout the season. In a few instances when the temperature of the water rose rapidly in the hatching house, incubation period was only three days. I should explain at this point that the water used in the hatching house was not taken from the river but from a pond supplied by a small stream which flows through the hatchery grounds. Ordinarily this water had a lower temperature than the river water, but naturally was subject to more rapid rise.

A noticeable feature in the work in 1907 was the great increase in the number of shad which entered the river. Fishermen, as far as I can learn, without exception, declared that more fish had been caught per net than in any single year since 1900. There were, however, less shore nets operated this year than in any previous year since 1900, excepting 1906. Although there were fully as many gill nets in certain parts of the river the fishermen combined and as a consequence notwithstanding the greater catch, prices ruled much higher than in former years even exceeding those of 1906. As a result nearly all the fishermen made money. One small shore fishery cleaned up over

$2,000. Throughout the season the prices ruled $45 for bucks and $80 for roes at the nets.

A catch of over 50 to a drift was not uncommon on the stretch of river between the Pennsylvania railroad bridge and Trenton. On one occasion there was taken from the department's own gill net 28 fish in a drift of less than a quarter of a mile. It was therefore not a lack of fish which caused the department's spawntakers trouble in securing eggs, but a lack of ripe fish. There were only 132 spawners caught. Indeed two of these were not quite ready to yield their eggs when taken from the nests.

The mentioning of these two fish recalls also another very curious fact, namely, the unusual large number of females which were within 24 hours of being ripe. A conservative estimate would be about four or five females in every 25 in this condition. The color would be brilliant about the vent and the vent itself would be protuding and when the fish was handled the eggs would be found to be loosened but could not be expressed. A number of these fish at different times after being caught were placed in a cool spot in the hatching house and allowed to lie there a half hour to an hour and a half and in two instances at the end of the period about two thirds of the eggs could be taken, but the hatch from these eggs was less than 50 per cent.

The first eggs were taken on May 5th from a fish caught by a giller and yielded 28,000 eggs, and this fish was secured after the water temperature of the river had been 60 degrees for nearly a week. The water temperature then fell to 58 degrees at which it remained until May 15th, with scarcely any variation. On May 15 there was a slight rise in the water temperature and on that day one giller took 49,000 eggs and 36,000 were taken from the Washington park fishery, the first taken from any shore net. From this time on until June 1st eggs were taken daily in small quantities and by the last of May there had been taken 2,602,000 good eggs. The highest take was 378,000 on the 17th, the water temperature being 58 degrees. On May 15 only 30,000 was taken with the same temperature. On May 13, 158,000 and on May 20, 283,000 with a 58 degree temperature. On May 31, 202,000 were taken. The weather was very warm; the water temperature a trifle over 58 degrees, but the water was muddy.

All the eggs were taken daily in the evening during May.

With the exception of two or three shad all were taken between four and ten P. M. Apart from the big days there was only an average of one ripe fish per day taken. From June 1st to June 20th inclusive, there were taken only 3,232,000 good eggs. On May 31, a female was caught which yielded 98,000 good eggs, the largest number of eggs ever taken of which the department has a record from a single fish. The fish weighed twelve and a half pounds.

On the same day a fifteen pound shad was caught by one of the gillers. It was a hard female. The owner of the net had intended sending the fish to the hatchery to be mounted, but unfortunately during his temporary absence from the net, his helper sold the fish for $2.00.

A curious feature of the run of shad in 1907 was that quite frequently when a ripe female was secured there was difficulty in finding a suitable male, and twice it became necessary to fertilize eggs with herring milt. Of these eggs only 50 per cent hatched. On one occasion a giller thinking a ripe male was in sight, took the eggs from a female but found the male was not in condition. He thereupon covered the eggs with water, set them in the seat and cast his net out immediately and made another drift although the state of the tide was not favorable, and after a lapse of little over an hour succeeded in getting a male. Notwithstanding this very long delay this lot of eggs were very fine. Over 90 per cent of them hatched.

For several years the laws of Pennsylvania and New Jersey relating to fishing on the Delaware river have not been uniform in accordance with the treaty or agreement between the two states which was entered into in 1794. Under the New Jersey law shad fishing closes on the 15th of June and Pennsylvania on the 20th. As a rule the shore men cut out their nets about the third or fourth of June on both sides and by common consent the gillers stop on the 15th. The Pennsylvania men stop usually because they are afraid if they got their nets beyond the midstream the Jersey wardens will arrest them. This year because of the unusual number of fish and the high price prevailing the owners of the shore nets on the Pennsylvania side wished to operate until the 15th at least, but some of the fishermen had other ideas and they were therefore compelled to cut out

a day or two after the usual period. By an agreement between myself and the New Jersey commissioners, we decided not to be too strict in the operation of the nets of those gillers who had been bringing eggs in regularly and on the 20th with the concurrence of the New Jersey commission, I issued employment papers to three of the best gillers operating on what is known as the Torresdale drift between the filter plant and Torresdale wharf with the intention if the experiment proved successful, to continue the operation of those three nets as long as eggs could be taken, even though it might extend into July. On Thursday night, June 20th, the three gillers took perhaps 400,000 eggs, but they were all bad. On the 21st a like number were taken and the eggs were all bad. The three giller's nets were therefore cut out. We operated our own net after midnight Sunday the 23d and caught two ripe shad and the eggs were worthless. Operations then ceased finally.

Referring again to the paragraph relating to the number of fish which were nearly ripe lacking only 24 hours at the most, this fact determined me to try some experiments, one of which was as I have already related, taking the most nearly ripe and laying them aside with the result already noted. A second experiment was to transfer specimens to one of the ponds in the hope that the fish would ripen. Unfortunately, we had only a gill net fhom which to take fish to try this experiment. The dozen specimens were therefore not in the best condition all being more or less bruised by the twine. Of the 12 fish 11 died within an hour. The 12th fish lived in the pond all night or until about dawn but the eggs could not be taken nor could they be taken from any of the specimens. We then determined to try holding fish in cribs taken from the Page shore fishery, the nearest seine to the hatchery, but unfortunately this determination was arrived at too late for the shore fishery cut out on the day we secured the lumber. This experiment therefore will have to lie over until next year. We had intended making a crib 12 feet long, four feet wide and four feet deep of boards with space of an inch to allow the water to flow through freely. Inside the box we intend to set a form or box of cheese cloth so that when the females were placed therein they could not harm themselves in their frantic rushes up and down the box or crib. As the question of

taking shad eggs has become not only on the Delaware but elsewhere a serious proposition an expression of interest has come from others who have been engaged in shad work as to the character of this proposed crib and whether something better can be devised.

The increased number of shad in 1907 in the Delaware river points in my mind to one inevitable conclusion, namely, that it is water temperature more than anything else which causes a marked increase or decrease in the run of shad rather than nets or pollution. I have no doubt whatever that improper nets and water pollution are factors, and perhaps large factors in this matter and therefore needs to take serious consideration by the states concerned. For example, in the Delaware Bay gill nets are in operation of very great length and in operation for practically 24 hours in a day. These nets are operated by Swedes and Norwegians who work with double sets of nets and double shifts of men. These nets stretch, relatively speaking, nearly across the bay and lap each other. The operation of such nets, of course, must have the result of preventing a full run into the river, but even these nets last year and for the five preceding years scarcely paid.

Small mesh shore nets unquestionably are an evil and catch and destroy thousands of small shad. Contrary to the usual belief we find that yearling shad had come into the river. They are about the size of a herring and I have seen heaps estimated to contain four to five thousand in the markets selling at 50 cents per hundred, or the price of herring. Hence a small mesh net must inevitably be a factor in destroying the fisheries and I feel that no shore net should have a mesh less than four and a half inches even in the pocket or bag. I particularly mention shore nets in this connection for the reason that on the Delaware river, notwithstanding the laws of both New Jersey and Pennsylvania require a minimum mesh of four and a half inches stretched measure, no giller uses less than five inches and the majority use a mesh of five and a quarter to five and a half, while most of the shore men use a net with a mesh in the pocket or bag as small as two and a half, as they claim, not of shad but of herring.

While I believe that improper nets and water pollution are

factors against an increase in the number of shad and perhaps have had something to do with the decrease in the number of fish in the six years preceding 1907, the results in 1907 show to my mind conclusively that there is something else of greater importance, namely, water temperature. It is a well known fact that shad come into the river freely when the water temperature is below 59 or 60 degrees and on examination of the records we will find that since 1900 and until this year the water temperature of the Delaware river during the greater part of the shad season has been below those figures. The source of the Delaware river is supplied by water from the mountain streams of Pennsylvania, New York and northern New Jersey. Beginning with 1900 there have been phenomenally late springs in those sections. There have been heavy snowfalls during the middle and latter part of April and even early in May throwing vast quantities of snow water into the Delaware river and so lowering the temperature. In 1906, for example, the average water temperature in the Delaware river at Torresdale was 57½ degrees during the first half of May and for the whole month of May it was only 59½ degrees. Between the 20th of May and the first of June the water temperature was a trifle over 59 degrees. In Wayne and Pike counties, Pennsylvania, and the adjoining counties of New Jersey and New York there was a nine inch snow fall during the month of May. The lakes and stiller streams of Wayne county and Pike had on several occasions a quarter of an inch of ice. This is from my own knowledge since I was in Wayne county at that time personally directing field work. In April it was less than 45 degrees for the last half. A curious fact in connection with last year was that the latter part of March and the first week in April the weather in the extreme upper Delaware was very warm and the temperature of the water went up, but the freezing and snow weather which I have mentioned began on the 15th of April. Exactly the same conditions prevailed in 1905. On the 16th of April there was 18 inches of snow in Wayne county. This year there was also a very warm spell in March so that the shad began to run very early and then came a very cold spell. During the month of April the lowest water temperature was 43°, the highest 56° at Torresdale with an average for the month of 49°. For the first

half of April the water temperature ranged from 43° to 50°, the second half from 43° to 56°. The average temperature for the month of May was 57.75°. The first week the average temperature was 60°, the second 58°, the third 57°, the fourth 56° and it will be noted that the greater take of eggs was in the second week of May. In June the average temperature was 61.38°. First week 60°, second week 61°, third week 62° and the fourth week 64°.

The greatest number of fish within about 24 hours of being ripe was during the third and fourth weeks in May with the temperature average below 58° and there was also during that period a notable decrease in the number of shad caught. The greatest number of shad caught throughout the season was in the two weeks in June and I have no doubt judging by the number of fish caught by the three gillers in our own net that the catch would have been much larger in the third week for each net that was in operation caught a much larger percentage than before.

If water pollution had been a very heavy factor in determining the run of shad there could not have been any great increase in 1907 over previous years for the reason that the river is just as badly polluted today by the cities of Philadelphia, Camden and Trenton as in former years and if anything the oil nuisance at Point Breeze was worse. The only effect that I could see in regard to the pollution was that after the water temperature became highest in June, the fish caught in the neighborhood of Torresdale tasted strongly of the pollution. The data therefore in the possession of the department leads to the conclusion that nature rather than man is responsible for the marked fluctuation in the run of shad in the Delaware river.

(Applause.)

DISCUSSION.

During the reading of the paper, Mr. Meehan made the following comments:

(1) I might add here that those eggs taken in Bay, were taken late in the season.

(2) Washington Park Fishery is below Philadelphia.

(3) Showing that with the temperature of the water going beyond 64° or 65°, as it did, the eggs were likely to be bad.

(4) Furthermore, the fish did not appear to have ripened any further, in the slightest degree.

President: This very interesting paper is now open for discussion.

Mr. George Mathewson, of Enfield, Connecticut: I was very much interested in Mr. Meehan's paper. Our experience on the Connecticut has been almost identical for this year. What interested me most was that you took the eggs and held them for an hour or more before getting the male to fertilize.

Mr. Meehan: That was one case.

Mr. Mathewson: You have not tried it any further than that?

Mr. Meehan: That was the only time.

Mr. Mathewson: We have been very short of male fish here in Connecticut. Lots of times we could have taken hundreds of thousands of eggs, and could not get the male fish to impregnate them. We never have been successful in holding them. I would like to know if there was a way to do it.

Mr. Meehan: This was done by the giller. We would not try it if we could get out of it. It was too risky.

Mr. Mathewson: We were not in just that position. Where we were, we could not get the females.

President: How many eggs did you get in the Connecticut?

Mr. Mathewson: About a million and a half of good eggs.

President: How was it with the number of fish there?

Mr. Mathewson: We had a very short season. While they were getting fish, the season was short; the temperature was down to about 53° or 54° all the way through there; had hardly any fish before the 7th or 8th of June.

President: I should be glad if you would speak on this subject of the pollution of the water, and fishing, and so on, as affecting the run. I should like to know your experience in

Connecticut. Do you feel the temperature in the river is an important factor in determining the number of shad that run in?

Mr. Mathewson: We have, of course, felt the pollution has been a great factor. We don't know exactly what to lay it to, entirely. We think that the pound nets at the mouth of the river are destroying more of our shad.

It doesn't give them a chance to come up in the river and propagate. We have not been able to get any legislation to get them out of the way. Our river fishing pound men are working seven days a week, and catch everything before they can get into the river to propagate. Then, we think the Enfield river has been a great factor in reducing the number of our shad. We don't get lots of them. The only place we have now, practically, to get shad, is on the Farmington river, in Connecticut. Of course we think pollution is a great factor.

President: You feel that your Delaware shad would get past those pound nets?

Mr. Meehan: We have no pound nets in the Delaware river.

President: I mean, the gill net in the bay.

Mr. Meehan: Some of them get by, because we catch them in large quantities above; but undoubtedly they take a great many fish. How many, we haven't quite the means of knowing, because those men don't make the returns to us, the same as other fishermen are willing to do. They seem to like to conceal it, push them off to this market and that market, and we have no opportunity of finding out how many they do catch. They are of enormous size. The fish get through the pollution. Of course there is no doubt in my mind that it is an enormous factor. My figures here have been borne out by the United States commission. I received a letter from Washington a few weeks ago. They asked me if I would not make a statement as to the character of the work and so on, and they write on the same line, that they have taken an increased number of eggs, and an increased number of fish in the other rivers, Susquehanna and Potomac, and the rivers southward,—an increased number of eggs have been taken, but the increase has not been

proportionately to the increases in former years. Now, whether that is due to the factor of pollution is something, of course, I cannot say. There is no doubt that it is a factor. But the fish do get through that pollution, and the pollution is just as great in the Delaware river as it was ten years ago, and there has been an increased run of shad in the Dealware river, showing that they must get through.

President: I should like to ask whether you think that the getting of say, five million fry, is going to keep up the fishery work in the Delaware river?

Mr. Meehan: No, I do not think five million fry is going to keep up the work in the Delaware river, not by a good deal. I think it will take a great many more than five million fry to keep up the supply in the Delaware river, with the demand that we have for that fish, not only in Philadelphia, but in New York. A large number of our fish go into the New York market, and Trenton, Camden and other points. Fifteen million will not begin to do it. That sort of thing, continued, simply means ruin for the shad fisheries. There is no question about that. We must try to devise some means by which we can get more eggs from the fish that come in the river, by some means, or through artificial means, in order to ripen the fish, somewhat on the lines they do with the whitefish; otherwise the shad fisheries are doomed.

Mr. Seymour Bower, Detroit, Mich.: I would like to ask Mr. Meehan if he has any idea what proportion of the shad which enters the Delaware river and the other rivers that flow into the Delaware are permitted to reach the spawning ground, or a point where they will spawn, if taken. Isn't it a fact that a large percentage are captured before they reach the spawning ground?

Mr. Meehan: Of course that is a fact, a large proportion. Nevertheless, there are a large number of fish that do reach the spawning ground. The natural spawning grounds on the Delaware river are above Trenton, from Trenton clear up to the New York line. Every pool above Trenton is a spawning pool, if of any size, and up to—well, even last year—I saw fish, and fish in

some numbers, spawning up in Monroe county. Quite a number of fish could be seen working back and forward on the surface of the pools, in the act of spawning, and there were quite a large number of young fish that went down the river last fall, and went down remarkably late. They didn't go down until nearly December, and it was the middle of December before the last run of young shad was reported to me. Of course the larger percentage of those fish are destroyed, there is no question about it.

Mr. F. N. Clark: This paper by Mr. Meehan on shad is very interesting. Mr. Meehan, I took shad eggs and hatched them on the Delaware river thirty years ago this summer—I think it is thirty—either thirty or thirty-one years. I think the most interesting thing, and the greatest experiment to be tried and worked out with the shad is penning. In 1883, 1884 or 1885, I can't give the year exactly, the United States Fish commission, with the rivers and harbors committee on appropriation, spent probably fifty or one hundred thousand dollars at Havre de Grace in building pens at the Battery station, for the purpose of penning shad. I was there one or two years. We made many experiments in that line, and we found that it was utterly impossible to pen the female shad and get good matured eggs. There was no trouble with the male. The male would go on developing, and we could use it, but the females would not.

You spoke of some you laid down in twenty-four hours that would not ripen. They were what we call plucked. It was impossible then to find shad that would ripen. If her eggs would not come—if she was not ripe enough so that they would come when she would come out of the net, they never would ripen in that pen. I don't know if any of you have ever been there and seen that pen in its early days, but it was built in as perfect a shape for holding fish as it could be, probably 200 by 300 or 400 feet, just as natural a place as could be for shad, excepting that they were confined in that. They were hauled even from the net—some of the fish hauled up, and not handled; they were hauled up in this apron and looked at; anything that looked as though it was about ready to spawn was taken out, and the balance was put in this pen, without handling them. I want to see the experiment continued to be tried. In my own opinion, I do

not think that you can ever hold a female shad until she ripens, on account of the kind of fish being caught. Now, if shad will spawn at a temperature down to 50° or 55° it might be possible for you to do it. To my mind that is the salvation of your shad work on the eastern rivers, if you can ever get them so that you can hold the female shad until they ripen, as you do the whitefish. Of course at an early day we did not think we could hold the whitefish. Now it is a matter of so many fish, so many eggs.

Mr. Meehan: It seems to me this is a matter which calls for the best skill of all the fish culturists who have anything to do with rearing shad, because we have no more serious proposition before us to-day than the shad. There is apparent danger of its becoming extinct. And unless something is done, or some means is found, as Mr. Clark has stated, of penning those fish, I see nothing before us but the loss of the shad in time.

President: Can't you rear those fishes at the mouth of the rivers? Isn't that possible?

Mr. Meehan: If we could secure uniform legislation between the states we might. New Jersey and Delaware have passed what they call a uniform law. It is uniform as far as it goes, but it did not have a thing to say about those long Swede nets, in the lower part of the Bay.

OBSERVATIONS REGARDING THE VARIETIES OF RAINBOW TROUT AND THE TIME OF THE SPAWNING OF THIS SPECIES

BY E. RAVERET-WATTEL

Director of the Fisheries Station of the Nid de Verdier, Fecamp, France.

The piscicultural Station of the Nid de Verdier has occupied itself for about 15 years in raising of the rainbow trout. *(Salmoiredeus)*. The fishes of this species which the establishment possesses in its ponds, come from two lots of eggs, which were kindly sent by the station at Wytheville, according to the instructions of the United States commissioner of fisheries.

The trout obtained from these eggs were at first nearly alike and belonged, we think, to the variety, which Prof. Jordan designated as the "McCloud River Trout," *(Salmo irideus Shasta)*. There were slight differences in color in a few of these fishes but scarcely noticeable. But, little by little, these differences became more accentuated. Although the fish were all placed in conditions absolutely identical, as to nature of water and kind of food, at each generation the differences in color became more and more noticeable and in fact there are now in the ponds of our station, specimens presenting the most diverse appearance. Some have a reddish tint, sometimes a little violet, spread over the entire body, and in these fish, the red band of the side is almost always very wide and of very dark shade; in others this band is of a very light color. Others are of a rather golden yellow, (jaune doré) sometimes light greenish, with the red band on the sides narrow and reduced, so to say, to a simple thread more or less dark. Finally, others, and they are today the most numerous, have an aspect generally very light, almost silvery, which immediately strikes the eye, even of people not interested in pisciculture. Thus the fisherman and the consumer of this region designate these light colored trout as "white trout" in opposition to the name of "red trout" of the Nid de Verdier which they give to the rainbow trout, whose general color is a little reddish, and which the station has planted in the rivers of

the Department of the Inferior Seine. In these streams is also caught the common trout.

The red band on the side of the white trout is usually quite narrow and lightly marked. At the same time that these changes of color appeared, more remarkable modifications were produced in these fish, by creating among the several permanent varieties perpetuating themselves by selection. Two of these varieties deserve special mention:

1st. In the trout which has a general reddish color and the lateral band wide and strongly marked, the abdomen is very large on account of the considerable size of the digestive tract. This is correlated with the voracity of the fish, which has an insatiable appetite. In both sexes the organs of reproduction occupy much space in the abdominal cavity, as spawning time approaches. The very voluminous testicles of the males produce an extraordinary quantity of milt; in the females the ovaries yield a great number of eggs, which are quite large and generally red.

This variety of the trout is extremely robust and easy to raise. The fry which are very vigorous, take artificial food readily, eat much, grow rapidly and are little troubled with sickness. In a word, the fish presents in the highest degree, qualities which determine the value of the rainbow trout, and which give it, so far as ease of raising goes, a very great superiority over the common trout of Europe. (*Salmo fario*). This variety is further distinguished by an interesting particularity: the early date of spawning. When we began to raise the rainbow trout, the laying of eggs of these fishes generally took place in February and March, with very slight variations each year, according to the temperature of the atmosphere and that of the water. But as little by little there was formed under our eyes the variety of "red trout" we saw that the date of the spawning of these highly colored fishes advanced in a remarkable manner, that is to say, that the laying of the eggs took place more and more early, first in January, then at the end of December, then at the beginning of December, and finally at the end of November. For the last five or six years, certain fishes, particularly early, permit us to practice artificial spawning from the 28th of November and even from the 26th. This is, of course, an advan-

tage, since we thus obtain fry, which, born very early, get, in their development a perceptible advance over the others.

2d. Our variety of light colored Rainbow trout, commonly called "white trout" is noteworthy for the small size of its digestive organs, which occupy only little space in the abdomen. The genital glands are small. The testicles furnish only a little sperm which obliges us to maintain a large proportion of males, lest we should sometimes lack milt at the moment when artificial fecundation is practiced. The ovaries are also very short, and give only a limited quantity of eggs, which are quite small, generally white or yellowish, rarely pink. The fry obtained from these eggs is more delicate, less easy to raise than that of the "red trout;" they require more careful attention, accustom themselves less easily to artificial food, eat less and very frequently die, at least during the early part of raising. They are wilder, more timid and in this regard resemble much the young European trout.

But if the "white trout" is not very satisfactory in this regard, it possesses the advantage of having a more delicate flesh than its congener. Although all our fish are, I repeat, raised in identical conditions, receive the same food and live together in the same ponds, the "red trout" is less palatable than the "white trout." Their flesh is a little soft and keeps less well. In consequence of the large size of the intestine always full of food recently eaten, which decomposes rapidly, the dead fish keeps fresh only a short time. This depreciates it a little with the lovers of fine dishes and affects its commercial value. The "white trout" is much desired because of the delicacy of its flesh, which has an excellent taste, is delicate but not soft and is easy to keep. Consumers who have had the opportunity to eat both forms (red and white trout) recognize the difference very easily. The merchants, also the restaurant keepers, etc. of our neighborhood, to whom the station is authorized to furnish the fish exceeding the need of the station, always ask for this "white trout," which are so much preferred by the connoisseurs.

In contrast to the change of date of spawning of the "red trout," that of the "white trout" has remained late and even very late. It hardly spawns before the end of February or the

beginning of March, at a time where all our other rainbow trout, even those which do not present a particular intensity of the red color, have already completely finished spawning.

I thought it would be of interest to bring these facts to the knowledge of the American Fisheries Society. I should be much pleased if these facts should be deemed worthy of attention by my honorable colleagues of the Society and I should be very thankful to them if they would kindly give their opinion regarding the causes which could bring about the production of such notable differences in fishes, having all, as it seems, the same origin, living in common, in the same ponds and receiving absolutely the same food. (Applause.)

DISCUSSION.

President: This paper is open for discussion. I should be glad to hear from some members who have had experience, if there is any story to tell in this country. Are there none of our trout men here?

Mr. Clark: I think Wisconsin has had experience.

President: We have had a lot of experience, but so far as I am aware we have had nothing at all that has been parallel to this. This seems to be a case of substantially the formation of a new variety, a very decided change in the habits, under new conditions. Of course our conditions in Wisconsin are not essentially different from those of the normal rainbow trout.

Mr. Clark: This is their native element.

President: We therefore, have very little that we can say, so far as I am aware nothing that parallels this. The paper does not go into discussion of the point, that we should all of us, at least those interested from a biological point of view, like to know, and that is, how this new variety was formed, whether it came as the result of somewhat rapid evolution on the part of a few fish or whether it was something concerning a considerable number of fish. He speaks of having two lots of eggs, and does not say whether this white variety has come from one lot of eggs, or from individuals belonging to both lots. Of course, if they came from one lot of eggs, something in the history of

those eggs on this side of the water might be responsible. But if that is not the case, and if has come about in a gradual way by individual fry here and there taking on this light coloration, I fear it is a problem that they will have to work out, because, so far as I am aware, nothing has been found in the hatcheries of this country. I shall be glad when I go back to make inquiry of the men in charge of our hatchery, and to put into the minutes of the society anything they may know and which I do not, which bears on this subject.

Mr. Clark: I would say, Mr. President, at Northville we are not doing anything with the rainbow trout now, except that what eggs are forwarded for us from some of the stations, we hatch, and grow fingerlings. We have rainbow trout in our ponds, but no eggs are taken from them. Nothing at all is done in that direction, and we know nothing about them except that we receive the eggs, hatch them out, and plant them. The principal work of Mr. Segall of Wytheville, of Mr. Dean of Neosha, and of Superintendent Johnson of Manchester is in connection with rainbow trout.

President: I think it would be well to send this paper to some of the gentlemen.

Mr. E. N. Carter, St. Johnsbury, Vt.: There are some rainbow trout at St. Johnsbury station, but they are not handled there any longer, and they simply died out; water did not seem suitable for them. Every spring the trout would come out with sores on their bodies, and many of them finally went blind, and eventually they were all turned into a stream near the station.

Mr. Bower: I would like to inquire whether these white trout and red trout all changed their spawning season, so that all practically spawned in November.

President: No, the red trout changed their spawning season, not all of them, so that the spawning season lasts from November into March, but the white trout have not changed their spawning season.

Mr. Bower: We have handled rainbow trout, but never noticed any such differentiation, nothing comparative. Of course,

we have steelheads and rainbows, and there is a slight difference between those two, but even those two species are more nearly alike than the white and red that he mentions, both in their appearance and spawning habits.

Secretary Peabody: What is your judgment regarding their edible qualities, as mentioned by him, the difference between the rainbow trout and others—is there any difference?

Mr. Bower: We find our rainbows are all alike, not good fish for the table.

Secretary Peabody: That is what he says.

President: His white trout?

Secretary Peabody: His white trout—he has got something else mixed up there.

Mr. Bower: I was just talking about trout with a gentleman, and I would like to have him state his experience.

President: We shall be very glad to hear it.

Mr. B. O. Webster, of Bellefonte, Pennsylvania: We have, at Bellefonte, Pennsylvania, a pond of rainbow trout, and our attention was called to the fact of their being ready to spawn in the later part of November, and the pond was drawn and at least one quarter of the fish were found ripe and ready to spawn. The males were especially ready with milt, and about one quarter of the females at that time, and within one month after that time, we finished spawning our fish. The natural spawning season of the rainbow trout varies, I know, in different parts of the United States, but Mr. Bower was saying it seems very queer to him that some trout spoken of in that paper should spawn at that time of the year, while in the northern part of the state at Corry, they find that their fish spawn in the spring, as they do in some other parts of the United States, where they are in their natural habitation.

President: How long ago was this, Mr. Webster, that these trout spawned in November?

Mr. Webster: Spawned last year and the year before. That was the first.

President: Their young have not yet come up to the point of spawning?

Mr. Webster: Their young have not. One year from next fall, their young will spawn.

Mr. Meehan: I can relate another rather curious circumstance about this. Many years ago, we received a quantity of rainbow trout from the United States government and hatched them in the hatchery at Marietta. The stock was divided in two parts. One was sent to Corry hatchery and one was transferred with the other stock at the Marietta hatchery to Allenton, the distance between the two stations being about 400 miles east and west. Now these were all from one stock. The fish at Corry hatched at the usual time, early in the spring. Those at Allenton spawned, and spawned regularly for years, about the same time as the brook trout, from the middle of October to the middle of November.

President: Your experience has been entirely parallel to that of the French hatchery.

Mr. Meehan: I missed the paper. These fish that we had at Bellefonte are not progeny of the fish there, because finding that the fish did not propagate naturally in the stream, the propagation of rainbow trout was for several years abandoned. And recently we took it up again on the idea that we could have our fish spawn in the spring, when our troughs would be empty; and the fish we are now having were from eggs received from the United States government. I think the fish over at Bellefonte came from Wytheville, but I am not sure. We now have some fish that will come into spawning at Corry this coming fall.

President: You expect them to spawn in the fall?

Mr. Meehan: I say this fall, I mean with this natural period they will come in spawn there this year.

Mr. Buller: I have a pond of these fish which came from Wytheville, Va., and some of them spawned in February, that

is, in a pond at a temperature of 46 degrees F. The water is very soft in the natural stream. I noticed in the month of March, California trout spawning in the stream.

President: The paper has two points, 1st, that the rainbow trout were beginning to spawn in the fall in France, and the other, that they were having a variety of white trout. Have you had any such experience of the formation of varieties?

Mr. Carter: Isn't it true that the rainbow trout of Wytheville spawn in the fall.

Mr. Clark: December.

Mr. Root: December and January.

Mr. Clark: They commence in December.

Mr. Carter: Naturally they spawn on the Pacific coast in the spring.

Mr. Fullerton: Mr. President, we in Minnesota raise rainbow trout. We have never found that they varied in their spawning at all. We tried an experiment four years ago; it was very funny to me; I never thought very much about it. Every fish culturist knows he will find very dark and very light fish in the same lot of fish. The superintendent at the St. Paul hatchery conceived the idea that he would take the male and female light and keep them separately, and the dark and keep them separately, and he has produced trout of very dark and very light color, and it occurred to me that if he would keep on with the experiment, separating the light and dark, he would get all light and all dark specimens. We have them at St. Paul swimming in the pond, through this experiment, taking the male and female of very light colors and mating them.

President: That is what one would expect.

Mr. Fullerton: We have a lot of those trout, and we raised them and sent a lot down to the Jamestown exposition this year. The funny thing about that is, taking a black female and black male, we have never been able to secure a single white one.

Mr. Carter: Wouldn't it be interesting to know what depth of water these fish are carried in that are so light in color.

President: Evidently they are living there under the same conditions. He speaks of conditions being exactly the same.

Secretary: Are the fish living on natural food or artificial food?

President: The writer of this paper does not state what he feeds his fish on, except that they are all fed on the same kind of food.

N. R. Buller, Pleasant Mount, Penn.: I have had a similar experience with California trout, and I attribute the variation in color to the feeding in ponds. The river-fed fish will vary very much in color. We have green, black and light variation of half a dozen colors, but has anybody ever noticed this among the trout where they receive their natural food.

THE CULTIVATION OF FISHES IN SMALL PONDS

BY CHARLES H. TOWNSEND

Aquarium Battery Park, New York City.

In presenting this paper to the Fisheries Society, I do so less in the hope of affording instruction to professional fish culturists like yourselves, than of creating some discussion of the subject and profiting thereby myself. For several years I have been experimenting with small natural and artificial ponds on private estates in the vicinity of New York, with a view to ascertaining their possibilities for producing the commoner fishes. Requests for information on the subject of home fish ponds are being made constantly by the public. I have arranged the matter under the general headings of "Natural Ponds" and "Artificial Ponds" and have attempted to present brief and general instructions for their management. The raising of trout is not considered in this connection. Trout require special conditions of water supply and temperature, seldom found on the farm. For the ordinary run of ponds, it is necessary to restrict the list of available fishes to the perches, basses and sunfishes to which they are adapted.

Natural Ponds or Lakes.—It is assumed that the position of the natural pond is such that no arrangement can be made for drawing off the water. Its possibilities will therefore have to be considered separately. Its fish life moreover can never be brought under complete control. If the character and abundance of the fish life in the pond are not known it is desirable that it be ascertained as far as possible by fishing or netting. If the pond is without any fishes it should of course, be stocked at once, and the selection of fishes made with due regard to its natural conditions. The extreme depth, mid-summer temperature, plant life and character of the bottom of the pond should all be ascertained. The summer bottom temperature of deep ponds should be known. It can be taken by lowering the thermometer in a pail and allowing it to remain some time. If pulled up rapidly the temperature will not have time to rise materially.

A series of bottom temperatures will serve to indicate the presence of bottom springs.

A wide area of shallow water in a pond not well supplied by springs or rivulets usually means great warmth in summer. If such a pond can be temporarily lowered and deepened in places, its conditions for fish life would be greatly improved as there is a decided difference in temperature between surface and bottom waters. Below six or eight feet the temperature decreases at the rate of about two degrees for each foot of depth. Increased depth would also give fishes an additional chance for life in winter when heavy ice diminishes their supply of air. A small pond, supplied chiefly by rainfall, may be increased somewhat in water supply by leading to it ditches from adjacent fields; while its depth may admit of some increase by embankments. If water can be had by boring, an artesian well may make just the difference between a poor pond and a good one. Fish ponds should have water plants to afford shelter for young fishes and harbor the various forms of aquatic life on which they feed. Several kinds of common pond weeds will serve for this purpose. The broad leaves of water-lilies afford shelter in summer for the large fishes and should be introduced. If the pond be very small and unshaded, some floating boards will afford shelter. Too many large fishes in the pond are detrimental since they are consuming the food supply and are themselves going to waste. When such fishes can not be taken with the hook as sometimes happens, they should be removed with a seine if it is possible to do so, and marketed. It is important that the mature fish crop of a pond be utilized and the young of the year be given a chance to develop. The accumulation of large fishes serves no useful purpose, but results in overstocking, exhaustion of the food supply, cannibalism and stunted growth.

If a natural lake or pond is already stocked with carp, which are not desired and can not be entirely removed, their further increase may be checked by the introduction of black bass which feed freely on young carp. Black bass will also keep other species in check by devouring their young, and thrive amazingly in the process. If the waters contain black bass, or other fishes, which have become stunted from overcrowding and the exhaustion of the natural food supply, it is important to reduce their

number by any methods of fish catching that will prove effective and to restore the food supply by introducing other species.

If numerous adult yellow perch are added their young will contribute to the food of the bass, and other large species. Experiments have shown that fishes stunted from overcrowding are not necessarily permanent dwarfs, but will attain a larger size if well fed or removed to more favorable waters. No fishes could be more stunted and worthless than those now swarming in the lakes of Central Park, yet we have succeeded in doubling the size of such fishes in two years. Stunted European rudd, transferred from Central Park to Prospect Park, began developing, and later, when we seined them out for exhibition at the Aquarium, it was found that their size compared favorably with that which they attain in Europe.

All ponds, whether natural or artificial, containing food-fishes should be stocked with brook-minnows, shiners, chubs, freshwater killifish or other small species to constitute a food supply. The killifish and other small species, it may be noticed in passing are useful in small ornamental ponds in destroying the larvae of mosquitoes.

The full use of the fish crop of a large natural pond or lake can seldom be secured by ordinary fishing. It is necessary that seines and trap-nets be used. Experience has proved that such ponds usually contain many large fishes which will not take the hook. The introduction of new adult stock may be desirable in an old pond where there has been in-breeding, but overstocking is the main trouble, the remedies for which are thinning out and re-establishing the food supply.

Owing to the customary preference for "game fishes," many excellent pond species, such as rock bass, calico bass, yellow perch, white perch, long-eared and blue-gilled sunfish and catfish, have been overlooked. Other kinds such as the warmouth or the white bass, inhabiting waters of the south or middle west, are equally desirable. All of these fishes increase rapidly, take the hook readily and are good fishes. They will multiply in favorable waters with less care than probably any other native fishes. With the exception of the catfish, they will take the artificial fly and afford good sport. They are of considerable commercial importance since according to government statistics, the

quantity annually sent to market exceeds twenty-eight million pounds. Nearly all of them are known to attain weights exceeding two pounds.

Ponds Made by Damming Streams.—Ponds created in this way should on no account be completed without the placing of drain pipes and penstocks, so that the water can be lowered and the fish life controlled. There are marketable fishes going to waste in ponds everywhere for lack of simple facilities for getting at them. The deepest portion of the pond should be at the lower end, where the fish will gather when the water is drained down. Ditches dug in the bottom of the pond, leading to the deep hole, or "kettle," will greatly facilitate the concentration of the fishes at that time.

Two or three ponds will be found to be much more satisfactory than one, since they will permit of the sorting of fishes according to size. Angling or other fish catching would then naturally be confined to the pond containing the large fishes. If properly managed, a series of fish-ponds will naturally yield a surplus for the market. It is dangerous to construct a fish-pond in a narrow ravine as the dam is liable to be broken during spring freshets or exceptionally heavy rains, and the pond will gradually fill up with silt. Even if the embankment is not broken during high water it is difficult to screen it so that the fishes will not escape. A safe plan is to make the pond at one side of the stream, by excavation and embankments, leading the water to it through a ditch, and damming the stream sufficiently at the ditch-head to divert a portion of its flow. In case of freshets, the deep pool formed in the stream by the dam at the ditch-head, naturally receives the silt brought down stream; thus guarding against the filling up of the fish-pond. The ditch itself should be screened at both ends to prevent the ascent of fishes to the stream, and keep floating drift out of the ditch.

If the pond can be excavated in marshy ground, so much the better. A layer of clay on the bottom will render it more watertight than it would be otherwise. The embankment should be broad, and before it is thrown up, all sod should be removed so that there will be no subsequent seepage caused by the decay of vegetable matter. The earth used for the embankment should also be free from sods or other matter liable to decay. The

ground cleared for the embankment should have a ditch extending its full length into which the new earth will settle, thus increasing the stability of the dam.

The embankment of the dam if it is to be six feet high should be ten or twelve feet wide at the base and four feet broad on top. The earth used in its construction will naturally be derived from the bottom of the proposed pond, which will, of course, serve to increase its depth. The overflow should be large enough to carry off the surplus, when the water is high, without danger to the dam and the outlets in general should be screened with wire netting to prevent the escape of fishes. The drain for drawing off the water should, of course, be put in place before the dam is thrown up. Earthen drain-pipes are risky, as no matter how closely the joints may be set and cemented, plant roots will eventually find their way inside and clog them up. Iron pipe of not less than four inches diameter, with the joints well soldered, is more reliable. A hollow log will serve the purpose of a drain-pipe, and wear well. If the drain, or bottom outlet, is built of concrete and large enough to be conveniently cleared, it would be more effective in lowering a large area of water. The upper end of the drain should fit tightly into the foot of the upright penstock in the pond. The penstock itself is merely an upright drain or sluice of planks or concrete, having about the same capacity as the drainpipe itself. It is fitted on one side with short "water boards" sliding in grooves which can be removed one after another, to permit the escape of the water. A heavy plank should connect the head of the penstock with the top of the dam.

Before the new pond is filled, all roots, stumps, rocks and everything else that would prevent the free sweep of a net along the bottom should be removed. All ponds, whether natural or artificial, accumulate debris of which they can not be cleared, expect when empty. A muddy pond will give the fish a muddy flavor. When a pond is being cleaned, it is necessary to remove the fishes from the deep hole or kettle. Any attempt to remove decayed matter and sediment, while fishes still occupy the deeper portions of a pond, may be fatal to them, as dangerous gases are then liberated among the crowded fishes. If the pond is very foul, it should be only partially lowered at first and the fishes re-

moved with a seine. With a reserve pond or two, it is possible, not only to thoroughly clean a pond, but to "winter" it: that is, leave the bottom exposed for a time to the action of the sun and frost. This destroys excessive plant growth and kills out destructive water beetles and other enemies of young fishes and is approved by most professional fish culturists. With a series of ponds constructed at different levels, the overflow of the upper ponds will serve to feed those below. The more fall there is to the water the better will be its aeration—a matter of great importance to small ponds. It is desirable that surface water caused by rainstorms be kept out of small ponds by banking up or ditching.

The following instances, among many which came under the writer's personal observation, will serve to show some of the difficulties in the way of successful management, where ponds are constructed without provision having been made for drawing down or seining:

A certain deep lake of about two acres in Connecticut, formed at great expense by damming a brook, is without any provision for drawing down. The conditions prevailing in it are unknown, and nothing but hook and line or some form of trap-net are available for ascertaining its contents, since its borders will not permit the use of a drag net. In the meantime, snapping turtles kill the young ducks on it each summer, and there is no way of getting rid of them.

Another pond, which could not be lowered, was believed to be without fishes, until the use of a seine in one corner showed that the yellow perch fry introduced two years before had already attained good size. The presence of snags elsewhere in this lake prevented the use of the net. The management of this pond will always be difficult and unsatisfactory.

A lake in the Zoological Park, stocked with yellow perch fry in 1903, was represented to be without fishes, until the use of a seine, sent from the Aquarium a year later, showed it to be well supplied. The full utilization of this lake is however impossible, since its bottom has many scattered rocks which prevent effective seining. If the rocks had been removed originally, a good sized seine would sweep it from end to end.

Water Supply.—The water supply of the fish-pond is the most important thing to be considered. It must in fact be taken into consideration before the artificial pond is made. The flow of water should be abundant. About twice as much will usually be required as the beginner thinks is necessary. Ponds fed by strong springs are excellent and are not subject to the dangers to which stream-fed ponds are exposed. Their temperature is naturally more equable throughout the year and they are less liable to heavy freezing in winter. In warm weather and in the winter time, pond-fishes avoid extreme temperature by frequenting the vicinity of bottom springs. Spring-water, however, contains less life available as fish food, and less air than that from brooks. Its value for pond supply will be improved, if it can be led some distance as a rivulet. Fish-life in small ponds with limited water supply will suffer from heavy ice in winter. The ice should be broken daily, and masses of brush and branches placed partly in the water will aid in keeping air holes open, especially if they are moved by the wind.

Extent and Depth of Ponds.—The extent and depth of ponds made by damming streams, will be governed somewhat by the nature of the situation available. A pond of an acre or more in extent, and with eight or ten feet of water in the deepest part, will, if properly managed, give excellent results. It may be necessary to make it less than one quarter of an acre in extent, but a small pond should have an extreme depth of not less than six feet, although it is quite possible with a strong water supply to raise fishes in very small and shallow ponds. This, however, means active cultivation, with daily feeding of the fishes, numerous ponds to permit of sorting, and all the details of a fish-cultural establishment. As a matter of fact, nearly all of the extensive fish-breeding carried on by the national and state fish commissions has been done in ponds of rectangular shape, averaging perhaps less than 100 feet in length and 25 feet in width, having depths of only three or four feet. Such ponds are worked in series, as nursery and rearing ponds, and there are generally two or more ponds of large size in which fishes of different growths can be held. Ponds to be used for black bass and in fact most other fishes, ought to be several acres in extent and quite deep. In general, fishes kept in small ponds do not

attain the size of those in large ponds since their range and food supply are restricted.

Feeding.—If large numbers of young black bass, rock bass or calico bass are removed for safety to smaller ponds where they may exhaust the natural food supply, it will be necessary to feed them. If they are put in small "nursery ponds" where they are crowded, feeding is imperative. The principal natural food of fishes is fish, which should be perfectly fresh. For young fishes it must be cut and boned, then rubbed through a fine wire screen. Adult fishes kept in restricted quarters will also require feeding. They may be fed largely on live minnows. Among the fish-foods used at the New York aquarium, are live minnows, live shrimps, chopped fish, beef, liver and clams. It is a mistake to suppose that fishes do not require an abundance of food. They may live without it but cannot grow.

Water Plants.—About one quarter of the ordinary pond should be as shallow as 10 or 12 inches and planted with pondweeds, such as potamogeton, parrots-feather (myriophyllum), water-celery (vallisneria), hornwort (ceratophyllum) and cabomba. Suitable plants for the purpose may be found in most streams and ponds, and there are many others than those mentioned. Water plants that are satisfactory in some regions may, however, not be so in others farther north or south. Water-plants are necessary as shelter for young fishes, and greatly increase the various forms of small aquatic life necessary for their food. They also serve to aerate the water, which is most important in small and sluggish ponds. They may be planted by tying to stones and dropping them from a boat, or set in the ground after the water has been partially lowered. The slightly greater depths, from one to three feet, may be planted with water-lilies, while the more extensive and deeper portions should be kept clear of vegetation. If the vegetation becomes too thick it can usually be pulled out with a rake, but it is sometimes necessary to cut it with the scythe. Willow and other trees should be planted at some points to furnish shade. Aquatic insects, crustaceans and mollusks, bred among pond weeds, constitute no small feature of the ponds food supply. It is recorded in the "American Fish Culturist," that an electric light over a

certain pond was found to attract insects which fell in the water in such numbers as to supply an important quantity of fish food. If the pond weeds, together with the brook-minnows, frogs, crustaceans and other small fry which are to establish the natural supply of food, can be introduced a year before the stock fish are put in, the conditions for success will be greatly improved.

Spawning Places. Fish-ponds should be supplied with spawning conditions suitable to the fishes occupying them. Small-mouthed black bass, which make their nests in gravel, will require gravelly bottom. Large-mouthed black bass, which nest among the roots of plants, will find the conditions they require among the weeds of the pond. Yellow perch, which spawn among twigs under water, are easily accommodated—pieces of brush may be set firmly in the bottom where the water is shallow, in the branches of which they will deposit large whitish masses of spawn. If the brush tops extend several inches above the surface of the water, so that they will be swayed by the wind, and kept free of sediment, the hatching of masses of spawn will be greatly facilitated. Rock bass and the various species of sunfish which, like the small-mouthed black bass, make their nests in gravelly places, will absolutely require places of that character if they are expected to increase and a few cartloads of gravel dumped around the lake in water about two feet in depth will furnish the necessary conditions.

Since ponds, to be successful, must have proper spawning conditions, some study of the habits of pond fishes is important and there are numerous helpful books available. It is now the custom with professional fish-culturists to supply artificial spawning nests in ponds containing small-mouthed black bass. These are small shallow boxes about two feet square filled with mixed gravel and sand, which early in the spring are placed everywhere in shallow water around the pond. They are at once appropriated by pairs of basses seeking spawning places. The boxes have boards nailed on two sides at adjoining corners, which extend about a foot higher, affording shelter for the basses similar to that which they naturally seek under the shelter of submerged logs. Basses guard their nets for several days after the spawn has been deposited, and it is the custom at fish cul-

tural establishments to place over the nest before the young fishes leave it, a light circular frame of iron covered with cheese cloth, one end of which protrudes above the water. This prevents the young fishes from wandering away from the nest, and makes it possible for them to be removed with the dip net to nursery ponds, where they are safe from their enemies and the cannibalistic tendencies of their parents.

One of the numerous private ponds visited by the writer, a pond half a mile in length, was examined with great care and found to be totally lacking in gravel areas. Although it had been stocked several times with small-mouthed black bass, there had been apparently no natural increase. With a mud bottom it afforded no spawning surface whatever for this species. The writer recommended the introduction of numerous artificial spawning nests, or the introduction of the large-mouthed bass which would not require gravel beds but could spawn among the abundant water plants. It is probably unnecessary to add that there should be no fishing allowed during the spawning season, which with most of the fishes mentioned is in the spring months.

Number of Fishes Required. In stocking waters it is not necessary to have a large number of adult fishes. For a pond of about an acre in extent, twenty pairs of black bass will be sufficient, and perhaps fifty pairs of any of the other kinds of fishes mentioned. These numbers will in fact suffice for still larger ponds and should be reduced for smaller ponds. When the conditions are right the progeny of the first year will usually stock the pond to the limit of its natural food supply. It should be borne in mind that heavy stocking serves no useful purpose, unless it is the intention to catch some of the adults the first year. It is just as well to stock with two or three kinds of fishes and time will show which species are the best adapted to that particular body of water. With black bass the yellow perch may be placed with safety, not only on account of the food it supplies to the former, but also on account of its own value as a food fish. It is remarkably prolific, and with a good start can usually take care of itself. The same may be said of the catfish. It is harmless since the basses and sunfishes are active in guarding their own nests. The yellow perch and the catfish may also be introduced into ponds containing rock

bass or calico bass. There is no reason why black bass, rock bass, and calico bass should not be kept together if the pond is of considerable size. (Applause.)

DISCUSSION.

During the reading of his paper, Mr. Townsend made the following comments:

1. We cleaned out some ponds, and found the lakes swarming with stunted fish, and by cleaning out some of the ponds, we actually succeeded in getting a good growth from stunted specimens.

2. That is the general run of pond fishes.

3. I may state now that the small ponds of the Zoological Park are now yielding almost enough fishes to supply the park, and that the food bill of this great Zoological Park has been very largely reduced, and we expect to learn enough about the ponds to make them produce very much more than they are producing now.

4. In referring to the size of the ponds, Mr. Townsend said: I think they are 100 x 25. I don't know for sure about that.

At the close of his paper, Mr. Townsend said:

I have presented this paper, Mr. President, in the hope of having it criticised by the members, as I am engaged in writing a more extensive paper on the subject of small ponds for private fish culture.

President: Mr. Townsend's paper is now before us for discussion.

Mr. Clark: In reference to Mr. Townsend's paper, I followed it very closely, and it is a very excellent paper. But, for the individual fish culturist, breeding certain kinds of pond fishes, I really do not see any chance for discussion. It is more on the line of fish culture or rearing fish on the farm. I do not think Mr. Townsend would advise having in our small black bass ponds, perch and sunfish and things of that kind, all in the same pond; and there are some other things that of course the fish culturist would not endorse in that line. I think his paper

is intended more for the general pond of fishes, and therefore I do not see any chance for discussion.

President: There is one small matter to which I would draw attention, for Mr. Townsend has written a general paper. The statement is made that after the depth of six or eight feet, the temperature will fall at the rate of about two degrees for each foot of depth. That is going to depend on the depth of the pond, and on the area, and while that may be true in ponds of very limited size and depth, yet if ponds are to be taken which will range from half an acre up to twenty acres, with considerable difference in depth, there will be found a good deal of difference in regard to this matter of temperature. There will be found a point in any pond of considerable depth where the temperature falls rapidly, but the depth and the rapidity will depend on quite a complex factor.

Is there further discussion of the paper?

Mr. Lydell: One feature of the paper was the large mouth black bass. My large mouth bass have all spawned on gravel this year, with the exception of two or three pairs. There were no beds placed for them, the old gravel beds were left in, and the large mouth bass sought the gravel, and all spawned there with the exception of three or four pairs, and I think I had the best success with the large mouth bass this year of any in my experience.

PLANTING FISH vs. FRY

BY JOHN L. LEARY

U. S. Bureau of Fisheries, San Marcos, Texas

There comes a report from all over this broad country of the growing scarcity of marketable fish, especially is this true of our Atlantic coastal fishes, and such varieties as visit fresh waters to spawn, along with the whitefish of the lakes, and I might say with all the varieties that are handled in the work of propagation. Much of this may be the chronic cry of the disappointed fisherman, yet I do not think we get the results, or that the catch of adult fish is what it should be, when compared with the immense plants of fry made, not only by the bureau of fisheries, but the state industries engaged in the work of fish culture. And while I have no specific remedy to increase the catch of our economic fishes I do believe that by building large retaining ponds in connection with our hatcheries, we could rear many millions of fish to the size of fingerlings, that would escape the many enemies that the poor little fry fall a prey to. Many fry are often made doubly weak by distant tranportation in close quarters, when planted are so weak and inactive that they are readily destroyed by minnows, small fish etc., that are abundant in most waters. Now with large retaining ponds, built at some convenient point to the hatchery, if possible near some stream or lake, where a certain number of fry could be reared to fingerlings, and the surplus fry could be planted as we are now doing, I think we could largely increase the catch of marketable fish. We will take the shad, one of the most delicate fish we handle, yet many of their fry were reared to fingerlings in the ponds at Washington, D. C., and liberated in the early fall. Many years ago when I was a fisherman, I observed often in the shallow waters along the shores of the Albemarle sound, schools of young shad making their way out to salt water, also many young striped bass, 3 to 4 inches long. This migration occurred during August and September. This proves to my satisfaction, that they could be ponded in fresh or brackish water for several months, a period that would change the little weak fry to a strong finger-

ling, fairly able to take care of themselves; and we know that all the fresh water fishes can be ponded with success.

San Marcos station has always planted fish and the results from our plants are most satisfactory, and some of them most wonderful. In the 50 acre lake at Jacksonville, that is now teeming with fish, this year they are catching bass weighing 5 and 6 pounds and one a few days ago weighed over 8 pounds. This lake we stocked 6 years ago. Roony and Butts, we supplied with fish 8 years ago. These fish were hauled from Monahans, on the Texas Pacific line, 60 miles to some fine lakes near Ft. Stockton. These lakes are now well stocked with fish, and Mr. Roony says that they catch some very large ones. Near Troup, we stocked a lake three years ago, and they are now catching many fish 18 inches long; and so it is all over the state.

And all these good results, arise from the fact that fish were planted, not fry; for I know from experience that if fry had been planted we would never have heard from them again, and I will say right here that I would rather have for stocking waters 100 fingerlings 3 to 4 inches long than 10,000 fry. Where fingerlings are planted I feel sure of favorable results, and very doubtful as to results where fry are planted. While retaining ponds, would be expensive, from the fact that they would have to be of large area, although not very deep, I believe that results would justify them, and I trust some day to see the plan tried. (Applause.)

DISCUSSION.

Secretary Peabody: Perhaps I might mention that Mr. Leary writes in connection with this paper: "I know this will not suit some of my fish cultural friends, as where fry are planted counts sound big, but like many other things, results in the end tell the story."

President: Mr. Leary's paper is now open for discussion. It raises one of the eternal questions. I have no doubt everybody here has an opinion except the president.

Mr. Root: I would like to give a little experience in brief. I went on the Rhode Island commission some twenty-five years ago, and we were buying fry by the thousands and putting them

out. The second year's experience with fry convinced me that we were throwing away our money, and I made an arrangement for raising those trout fry until the following October and then redistributing them; putting 125 fry in a can and carrying them right to the streams, and the result has been that our streams have been stocked thoroughly. We could not stock with fry; it was impossible. We were laughed at all over the country, especially by Massachusetts but we kept on, and we know that it is a success, and I believe it is the only way to stock streams.

President: Any further discussion on the paper? Has anyone a good word for the fry?

Mr. Titcomb: I believe that is a tabooed subject. I am only going to say a few words. We could talk all night on this question and then not get through with it. The question seems to be one partly of finance. When you consider, for instance, the work of the bureau of fisheries, taking the output last spring of white perch, something over twelve hundred million fry, it is practically impossible to consider the idea of rearing them to fingerlings. The whitefish comes in the same category. It seems to be a question of when you can do it, and when not. Some species we know, produce good results with fry. I might give specific instances where brook trout fry and lake trout fry have been planted in ponds, where there were no such fish, and in three or four years good fishing prevailed. The policy of the bureau is to plant fingerlings of trout and bass where possible to do so. But the production is so large and the facilities for rearing to fingerlings so limited in proportion, that it is necessary to plant a large proportion of fry.

In the bass work, we have found that one can hatch in an area of one acre 100,000 little bass. Those little bass feed on minute aquatic life; we cannot feed them; and by the time they are ready for distribution as fingerlings they have eaten each other until the total number has been reduced from 100,000 to anywhere from 5,000 to 15,000. It has been found that in the same pond, by seining out the early hatches of bass fry to the number of say 50,000, and leaving balance to grow to the fingerling stage, it is possible to plant 50,000 fry in suitable waters, where they have plenty of range and plenty

of food; and then two or three months later you seine out just as many fingerlings as if you had not taken out any of them as fry. That has been demonstrated by actual test at one of the pond stations. With the brook trout, it is customary to plant a part of the fish, to relieve the overcrowded condition of the stations, just at the time of absorption of the umbilical sac.

The planting is conducted almost continuously at many of the hatcheries for five or six months after that, the fish being planted as Nos. 1, 2, 3 and 4 fingerlings. It all seems to be a matter of conditions and funds to do with.

President: I should like to ask whether any experiments have been made which are in any way conclusive as to the relative advantages of fry and fingerlings, including the cost of rearing, the total product of the pond, and the results in stocking. I have heard men talk time and time again, and each is positive his way is right. But I have never seen an account of any experiment which really determined it definitely one way or the other.

Mr. Titcomb: It seems almost impossible to make them, because no two streams and no two waters have conditions which are exactly the same. You might plant fry in one stream and not get results, and in another get good results, and in the first stream the fingerlings may produce results.

President: That is perfectly true.

Mr. Titcomb: I think the fish culturists who have stocked these streams for years, can as a rule pick out the streams in which trout fry would produce results, and pick out the streams in which to plant fingerlings. It is a difficult question to consider, taking into consideration the large number of applications and the answers to the questions which are sent to the office on the regular form.

Dr. Tarleton H. Bean, New York City: Mr. Chairman, I do not want to begin a lengthy discussion of this question, but I want to supplement what my friend, Mr. Titcomb, has said about the distribution of fish when the extent of distribution becomes greatly enlarged, as it is in the United States bureau,

and in many of the states. Fish distribution is a very different problem now from what it was when this society first originated. We were then planting hundreds of thousands; we are now planting pretty close to the billion mark, even in some of the states, and the United States has run into several billions, I understand, from its last work.

The question of cost, then, which Mr. Titcomb has introduced, is a very important one, and in fact, it is so important that it must be considered whether you will or no. It is not what you want to do, but what you can do, with the money appropriated for the purpose.

Another thing which I might mention here in favor of planting younger fish than fingerlings, because that is what a great many of the states are doing—what New York is doing now—is, that we escape a great many terrible epidemics by so doing, which would, we know, perhaps three seasons out of ten, sweep the whole product of our hatching establishment. This is another thing we escape by planting the fish early. Suppose there should be an unusually warm season, with little rainfall, it would mean the destruction of trout unquestionably. Now, if you get them out early, you save all this loss. It is nature's way, Mr. Chairman. Nature does not plant full grown fish. She starts them as little fellows out of the egg. It is true she has little devices for taking care of them which we have not; nevertheless, she does not plant full grown fish. There is only one creature that I ever read about that sprang full grown into existence, and that was Minerva from the brain of Jove. We cannot do the same, when we are limited by the amount of work we are called upon to do, by checks on over-production, by the wants of our applicants, by our financial limitations and other surrounding circumstances, and so on. You might go on discussing this question forever; and I think that those who believe they are doing right, saving money and time, by planting fry will plant fry and those that get better results from planting the fingerlings will plant fingerlings.

Mr. Titcomb: I think it proper to call attention to the fact that Mr. Leary's work in Texas has the hearty approval of the commissioner of fisheries, namely about planting fingerlings. It

is due to local conditions that he is able to do it, with the bass and sunfish which he propagates, as he has a tremendous amount of food there. The black bass have been known to grow to about eleven pounds in three years, illustrating the great amount of food that they find, and Mr. Leary can gather any great amounts of natural food in the vicinity of his pond. The fish there at two months of age, I think are two and three inches long.

There is one more point which I want to bring up in connection with the general subject, and that is in connection with the commercial fishes, the perch and whitefish and all of those that are propagated in large numbers,—the shad, for instance. The work of the states and of the bureau of fisheries, consists in saving the eggs which otherwise would go to waste in most instances. It is the saving of the eggs taken from fish netted by commercial fishermen, going to market. This is generally understood by the fish culturist. We might say it would be better to propagate and rear them to fingerlings, but we are trying to save just as many eggs as possible which otherwise would be destroyed—the eggs of fish going to market—and that is the principal work.

President: I am very glad that Mr. Titcomb made those remarks. I had the pleasure of visiting the hatcheries some years ago and considered the work he was doing and also the type of waters. It was quite obvious that the fingerlings—or the ponds in which they went—small lake, shallow water, weedy, and frequently with other fish there ahead, which would eat up the bass minnows put in, with comparatively small chance for the fry to find concealment—that in waters of that kind, the policy which he was following was entirely right. I am not at all convinced it is right for bass with the lakes we are dealing with in our Northern states.

I would like to refer you to one other matter. It seems to me Mr. Atkins paper last year was extremely valuable to this discussion,—showing that the trout fry were able to stand starving for a considerable time, with no apparent injury at all. One of the difficulties which always seemed to me attended the planting of fry was the fact that they were turned loose at a time when there was comparatively little food in the brooks, and it

is evident that nature has adapted the trout fry to that condition of things, for Mr. Atkins has found that they could be starved for an astonishingly long time and come out as those fish did with comparatively small mortality. I must say that his paper encouraged me in his fry theory. We have worked in Wisconsin, partly from choice, partly from necessity; we have certainly found that a great many streams that we stocked with fry, have become rapidly filled up with fish in good condition. The thing I would be glad to have some facts in relation to, is just the question which Mr. Leary raises, that each 125 fingerlings are as good as 10,000 fry. That is something I do not know anything about, and I have not been able to find anybody that knows about such comparisons.

Mr. Seymour Bower: I just want to say a word on the subject. It would depend a good deal on the condition and circumstances and time. Now in our state, we planted brook trout only as fry, and we know that we have had the very best results. We know this, because, as the president stated about the streams of Wisconsin, they contained no trout until stocked with fish in the form of fry. All of the trout streams in the lower peninsula of Michigan, with very few exceptions, contained no brook trout whatever until stocked with fry, and today some of those streams are among the best we have in the state.

There is another point in regard to the planting of fish as fry. If they are held as fingerlings, the distribution is not only far more expensive, but you are almost certain to have a greater loss. Now we can distribute trout fry without any loss during the season, but when you undertake to distribute them as fingerlings, along in July, August and September, hot weather, that is a pretty difficult proposition. You not only lose a good many, but it is far more expensive, and we have firmly come to the conclusion that on even terms of cost, we get greater results—final results—from planting the fish as fry than from fingerlings. In other words, a dollar expended in the form of fry goes further than a dollar with fingerlings. Of course it depends a good deal whether they are properly planted or not. If I were going to introduce brook trout into a pond or outlet of a cold pond, I would deposit fingerlings. But we aim to have our fry

in spring brooks where there are practically no other fish to be found, and where the natural food of the fry in found—in fact where the adults themselves come to pass their spawn, and in this connection I would like to ask Mr. Root if the fish planted by him as fingerlings propagated, reproduced.

Mr. Root: That is a question I cannot answer. I do know that all the streams in Rhode Island have been thoroughly stocked. There used to be from all those streams a good many dams, saw mills, and everything of that kind. Most of those things are gone. The small industries have pretty nearly all gone into the trusts' and capitalists' hands.

But, about the distribution of fingerlings: We don't put out any fingerlings until October and November. Then we buy them, and pay $25.00 a thousand for fingerlings from 3 to 5 inches long, and they are weighed out to us. Now, we put out 125 in 8 gallon cans, that is all we put in, and we never lose any. We send a messenger with them. Of course that is some expense, but the state is willing to pay that for the benefit of the fishermen, and we pay it, and put our bill in, and it is paid. There is no question about it. Of course we are not here to antagonize the government with their billions, but if they would cut that down they would get better results on trout. I don't know anything about anyone else,—that is what we get.

Mr. Bower: The reason I asked that question, was that it occurred to me that if those trout reproduced they must go somewhere to spawn. In other words, have you got to keep your streams stocked, by keeping yearlings all the time instead of having some assistance from natural reproduction?

Mr. Root: That is just what we do, and what we expect to have to do, because most of our streams get very low in the summer, and a good many of them dry up. If we put them in in October or November, we will get fish large enough to catch without any trouble at all. I have put them into a pond—and cut the ice to put them in—as late as December, and a year from that following spring, taken out trout that weighed three-quarters of a pound, plenty of them, it is not an uncommon occurrence. We rarely get one that has been in a little over a

year—from December to the following spring—that does not weigh from half a pound to three-quarters, and I have seen them up to a pound and a quarter. That is a fact. I have been right at it—followed it up for 23 years.

Mr. Meehan: Mr. Chairman, my experience is the same as that of Mr. Seymour Bower's. We found we obtained the best results by the planting of the fry, and that experience has extended over a number of years. And also in regard to the other fishes that Mr. Titcomb spoke about, we have to propagate them in such large quantities that it would be folly to attempt to do that on a smaller scale, and we have also found remarkable results from the planting of the fry of some of the other fishes. Take, for example, the yellow perch. I will just give one example that came to my attention within the last few months.

Year before last we planted a large stock of yellow perch fry in a town in Wayne county, in which that fish did not exist previously. The pond was a large artificial one, intended for a reservoir for the Delaware and Hudson canal, many years ago, and it was filled with pickerel, and what was known as the "shiner," I think, or the roach, but no perch whatever. We made a plant year before last, another last spring, and one this spring. This spring there were good yellow perch fish in that pond. It is a pond we use for getting bait for our bass. The superintendent reported very frequently he caught quite as many yellow perch as he did bait. There was an example of planting fry. These fish were planted within twenty-four hours, sometimes within six hours after hatching at that particular point, illustrating the possibility and the good results that can follow the planting of actual fry.

And the same results followed our trout. Our trout fishing to-day in Pennsylvania is better than it has been for many years. Five or six years ago it was scarcely worth while to go out on a trout stream. To-day the trout fishing is good.

Mr. Fullerton: Mr. Bowers' statement is really the meat of the whole argument. Get them up to the tributaries of the main stream, and you will always get good results. There is no mistake about it. We have tried it in Minnesota, and we have tried a method I think a great deal of. We send the fry

out to the people, especially in the southern part of the state, where the streams run right past the villages, and they make the ponds themselves and turn them out, and they claim they have splendid results. But I know that for the planting of fry, if they are planted intelligently, that is the whole thing—the whole meat in the cocoanut. If you plant in streams where they can get down you will have better results.

Mr. E. Hart Geer, Hadlyne, Conn.: Now I am a firm believer in planting fingerlings, and yet I am liberal enough to believe that where fry are planted successfully and good results are obtained, that that is the best way to do. In Connecticut and mostly all the New England states we find that the fingerlings are the proper thing to plant for trout. In regard to black bass, I will state a little instance. I believe the fry, or, as some have termed it, the advanced fry, are just as good as to rear them to fingerlings. The Housatonic river, which was a noted bass river in Connecticut, was almost depleted of black bass, and the commission planted several thousand of these advanced fry, and reports come to us that in that river the small bass are seen in great numbers. And that seemed to me rather conclusive that black bass planted as fry are successful.

President: A man may be pardoned for his first offense.

Dr. H. M. Smith, Washington, D. C.: With Commissioner Bower's permission. I should like to refer to the question of raising shad in ponds at Washington, which the gentleman who has just spoken has referred to. There were, in previous years, some very noteworthy results from planting shad fry in fish lakes in Washington, and in the fall we turned out many thousands, perhaps millions, of yearling fish. But the recent experience of the bureau of fisheries was decidedly unsatisfactory. We planted in one large pond that had been used in previous years for this purpose, approximately about two million or two million and a half fry—I think it was about two million—and in the fall we drew down this pond, and as near as I can recollect, turned into the Potomac river thirteen hundred small sunfish, and several hundred Warmouth bass, a few black bass, a few hundred yellow perch, and two or three hundred river herring, and one shad.

(Laughter.) That experiment was repeated another year, with no better results. Now, whether the fault was in the method, carelessness in permitting predacious fish to get in, I don't know. The screens were up, so that as far as we were aware, these young fish must have gone in as fry, got a start, and preyed on the defenseless shad. I believe, Mr. President, the planting of a few million shad fry in the Potomac river would produce equally as good results.

Mr. Titcomb: I want to say we did not have a chance to have a fair and complete experiment. That work was done for a number of years, and it was supposed and reported each year that a number of these five and six-inch fry were turned in, but they were never counted, because handling shad at that age is very destructive, and these attempts were with a view to getting actual results. In each instance the ponds had got stocked from the eggs of Potomac river fry, or other fishes. We learned that the growth of the shad was about six inches. We have the one specimen which we obtained as the result of those plants, which we can exhibit to prove that.

President: Perhaps this shad ate up all the others. (Laughter.)

Mr. Titcomb: I want to ask Mr. Geer one question, whether he knows how many fish, approximately, he has been able to turn out of these ponds from the plants he has made, whether any attempt has been made to get at results?

Mr. Geer: Mr. President, I am surprised at Mr. Titcomb's asking such a question. He just said a few minutes ago it was impossible to count the shad. (Laughter.) Now, then, I will give you some figures of the catch of the adult shad. In 1889, if I remember the date correctly, we had something like three hauls of shad fry from the United States government and planted them in our retaining ponds on the Connecticut river. We did not stop to count the fingerlings as they passed out, although we knew they were shad, as we saw them when they passed out of the gate into the river. They were not sunfish, they were not other fish, they were shad. In four years from that time, the catch on the Connecticut river had reached about one hundred

and seventy-six odd thousand, which was a gain in less than ten years from an eighteen thousand catch; while from that year, from 1889, down to the present time our stocking of shad has been less and less every year, and the catch on the river has been less every year. Now to my mind it proves conclusively the benefit of stocking—of holding the shad fry in retaining ponds, away from their natural enemies, until they have reached three, five or six inches in length, then allowed to go down into the salt water. Furthermore, years ago, before I went on the commission, a great many shad fry were hatched on the Connecticut river and on the Housatonic. A great many were secured from the United States government and planted at Housatonic, thousands more than were caught. And yet, the shad in that river are gone forever, and we cannot get them back, not even with the retaining pond, to be self-supporting. I am thoroughly convinced and believe in the system of the retaining ponds for shad. Our river shows it. According to the number of shad fry you put into those ponds and release in the fall, the catch in the course of three or five years increases.

Mr. Clark: I did not suppose it was possible for me to keep my seat as long as I have when the question of fry vs. fingerlings was discussed. And I do not suppose that any of my friends here thought it was possible. But I have done so, and I have not felt at all like getting up and discussing this question. For twenty-five years this question has come up more or less. I think, if I am right, that I was the first one that ever brought it up before the meeting of the American Fisheries Society at New York City. At that time I was firmly convinced and positive that there was nothing right about planting fry. Like my brother Geer here, I am frankly willing to listen to the fry man,—and, gentlemen, you that advocate planting fry are right; and gentlemen, you that advocate planting fingerlings are right. It is only a question of the fish and the place. Now, this fingerling vs. fry question is discussed from time to time, but we all are of the same opinion still. (Applause.)

Mr. Titcomb: I am not talking this time on the fry vs. fingerling question quite. It seems to me, Mr. Geer's argument on the shad question is not entirely fry vs. fingerlings. It is

more a question of the place where you plant them. He plants his shad fry in some ponds that are free from other fish. I do not think Dr. Smith would have you understand that the experiments of the bureau were entirely satisfactory, or carried to a conclusion. There was some evidence that more than one shad got out of the pond in years previous to those in which we made the count. But I for one, am very sorry that the experiment could not have been continued another year, with the hope that we could have filled a pond with water, without supplying it with the eggs of other fish, and then stocked it with shad, even if we lost every fingerling shad when counting them. I think it would have been a contribution to the fish cultural knowledge of this country, to have destroyed every one of those million shad, if by so doing, to find out the results from planting fry in a pond of that character were definitely ascertained. I hope that the Connecticut commissioners will sacrifice the shad in at least one of their rearing ponds one season, or such proportion of them as it is necessary to sacrifice, in order to ascertain somewhere approximately at least the number of fish which grow up to fingerlings when planted under those favorable conditions. We know that the planting of the shad fry in the various rivers by the bureau of fisheries has produced tremendous results. I understand that yesterday the reasons why the shad fishery has been going down in the last few years were fully explained.

Mr. Geer: I might tell one thing connected with our Housatonic retaining pond. While we sacrifice virtually the shad and know that a great many of them reach the fingerling stage.—to explain that point: It has a long brook which runs into it. That brook is full of pickerel, and when we came to draw it off the year following the October we planted the fry there, we ripped the pickerel open and picked out two to four or six shad —every one of them. We sacrificed that shad. And another is on our Connecticut river, on which we have three ponds there in a chain. In the upper pond there were a great many little fry put in there in the last of August or first of September. There came a cloudburst which raised those ponds to something that we never knew before, and before the superintendent could get

down and take the screens out, the water had risen and rushed over, and brought those little shad, then about two inches long, and plastered them on that screen and killed them all. I didn't count them, but there must have been a million of them. That was a great loss—we so considered it. That was the upper ponds, of course the lower ponds escaped.

President: Any further discussion of this paper? I think Captain Leary's paper has served its purpose of raising a discussion.

EXPERIMENTS IN RAISING BLACK BASS BY TAKING THE NESTS AWAY FROM THE PARENTS AND HATCHING THE EGGS IN TROUGHS

BY EDWARD A. BIRGE, MADISON, WIS.

The facts that I may report are simply these: A year or so ago we lost a very nice lot of black bass eggs in our hatchery at Minocqua, owing to a sudden fall in temperature, and chill of the water. The foreman of the hatchery said to me, "I wonder if it would not be possible to take the eggs from the nests." I asked him to make some experiments on the matter this year. He did so as far as he was able, but had so many fry to take care of that he was able to do only a small part of that work which he and I had planned together, and therefore the experiment cannot be reported on.

The only thing that can be said is that it is perfectly possible to remove the eggs when first laid from nests and to hatch them on trout screens, furnishing healthy fry; but the experiments have not yet gone far enough to warrant any report on the matter at present.

QUESTION BOX.

The first question is as follows: In discussion before the society last year, Mr. Lydell states that he has been reducing the number of adults to the pond ever since he has been engaged in the propagation of fish and gets better results all the time. Does he mean a larger number of eggs per fish, or is it better results from the fry allowed the liberty of the pond? The point is this: Do increased numbers of adults in the spawning pond decrease the production of fry, providing always three hundred square feet is allowed to the nest, as advocated in Michigan fish report for 1903-4?

There are a number of questions here.

Mr. Clark: I would like to inquire who it is from—a member of this society or not?

Secretary: It is from Mr. M. F. Stapleton, of the department of commerce and labor.

Mr. Clark: Is he a member of this society?

President: He is from Mammoth Springs, Arkansas. Mr. Lydell, I suppose should answer, if he is present.

Mr. Lydell: My experience has been that by reducing the number of adults I got a better percentage of eggs from those that do spawn, and get better results from the fry that are to grow to fingerlings. If you get too many fry in your pond you do not get nearly as good results as you do with less, and with your breeders, if you put a few in, you get a few good nests, while you get nothing the other way. In ten of our ponds we put twenty-five breeders and we would get ten or twelve good beds.

President: Twenty-five to what acreage?

Mr. Lydell: The ponds are about 150 x 200 feet. With only fifteen pair of bass in a pond we could get better results than when we had fifty.

President: How many square feet would that be to the nest, in case it was 300 square feet?

Mr. Lydell: You can figure it out. The ponds are about 150 x 200, 15 pair of fish in there.

Mr. Clark: Ponds 10 x 10 to each nest.

President: The next question is: Where all fry are transferred from retainers to rearing ponds, or distributed, what but the spawning area available can govern the capacity of the breeding pond?

I suppose you would say that where the number of bass is large they crowd and disturb one another?

Mr. Lydell: Yes, as I understand. I found one season I had a large number of fish and good results, but have never done so since. I find in late years that by reducing the number of breeders I have had no failures.

President: The next question is: Which method of rear-

ing is looked at most favorably by the small-mouthed breeders, —to transfer the fry to rearing ponds, or give them the freedom of the spawning pond by removing retainers? Is it known that any harm results from netting the fry?

Mr. Lydell: We have had the best results by leaving them right in with the adults. Last season we prepared one pond for a rearing pond. The water was drawn out and the pond cleaned thoroughly, and the vegetation left to come up; then we introduced about 20,000 fry, and did not get near as many fingerlings as in a pond of the same size with fifty old bass. The reason I give for it is that everything got in and ate up the food, and that if I had left the old bass in there to eat up the pollywogs and trash, I would have had the food for my young fish.

Mr. Clark: We remove some of the fry from the spawning pond to other ponds that have no fish in them, and leave about half in the spawning pond. In other words there is about double the quantity of fry in a pond where they have spawned that the pond will take care of; and by so doing we find we can rear just as many as if we did not take any out.

Mr. Titcomb: May I inquire whether you feed them, or do they depend entirely upon the natural food?

Mr. Lydell: We fed them as far as they would take the food. Our ponds to-day are full of small-mouth fingerlings, and the old fish are in with them.

Mr. Titcomb: What do you feed them?

Mr. Lydell: Liver, every day, every afternoon at two o'clock.

Mr. Fullerton: I might say we feed ours at 2:10.

President: Is that the difference in time between the two stations? (Laughter.)

Mr. Carter: I should like to ask Mr. Lydell if he had any difficulty in teaching his black bass to eat liver?

Mr. Lydell: To a certain extent, we do, but they come to it after a while. Our liver is cut up into strips about as large as a pencil and two inches long, and they feed every day. There is

not a day, except when it is very cold, but what they will come up and feed. I took a number of bass, and quite a number of them had crawfish and liver in them. I took them out after they were fed, to see if they had taken the liver. But you will find it takes about two weeks to get them to feed on liver. We feed in one place, and keep continually at it. But they do come.

Mr. Carter: I should like to ask Mr. Lydell how he keeps up his supply?

Mr. Lydell: We introduce new bass every season—a few—out of our stock pond. This season I think we lost six adult bass.

Mr. Carter: Do you get better results from the bass you introduce each spring?

Mr. Lydell: I get better results from the old ones.

Mr. Carter: I have had the reverse. Each spring we have been obliged to replenish the stock by taking them from Lake Champlain and transferring them to St. Johnsbury, and almost all of the fry shipped out from St. Johnsbury have come from eggs of fish taken from Lake Champlain the same spring, and the fish held over from one spring to another yield a very small quantity of eggs.

President: Are you able to feed these fish that are held over?

Mr. Carter: Yes, during the first part of the season we are. We feed them on shiners, small perch and other fishes of that character taken from a nearby stream, but later in the season the food supply falls off.

Mr. Titcomb: May I ask a question as to that particular feature of the paper—as to the advisability of feeding shiners to the brood fish while the fry are still in the ponds?

Mr. Lydell: Something we never do is to introduce a live minnow in our bass ponds before or during the spawning season. I have known them to clean up a whole pond of fry by having them in there. There are so many weeds that the old bass can-

not catch the shiner or chubs or whatever they may be, but they can lay around and get the fry. For the last two years we have not introduced a live minnow into our ponds during the spawning season.

Mr. Carter: I have recommended to the Washington office that they construct at St. Johnsbury one large bass pond in which all the bass are to be held during the periods when they are not spawning; and my recommendation is that in the spring of the year before the fish are ready to spawn they be sorted out and transferred to a medium class of pond, measuring 25 x 15, or about that area. Then my idea, as soon as the spawning season is over, is to take the bass and put them back in the stock pond. My idea is to make that pond as large as we have room for at the station, and to keep it well stocked with coarse fishes and during the time they are out of the pond the food will be collected, and when they get back they will find food, and there will be none of the coarse fishes in the spawning pond, and the young will be allowed to grow without being molested.

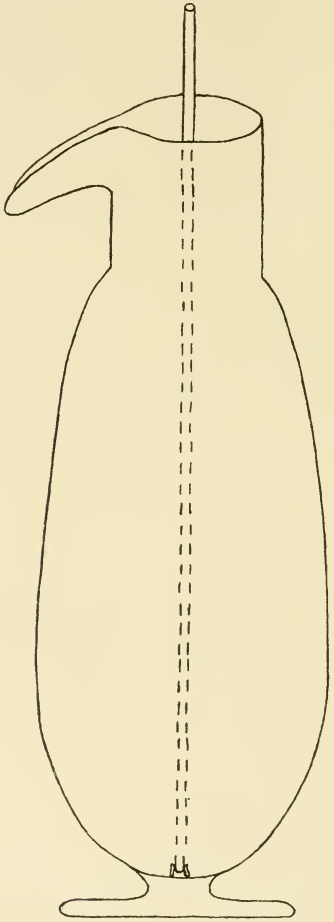
NOTES ON A NEW HATCHING JAR

BY FRANK N. CLARK, NORTHVILLE, MICH.

Of the various open top jars heretofore invented, but little attention or consideration has been given to the formation of a jar so shaped that in operation it would be automatic to the extent of separating the live from the dead eggs. Believing the construction of such a jar to be entirely feasible and within the limits of probable success, experiments were undertaken, the final result of which has been the successful demonstration of a new form to be designated and known as the Clark Hatching Jar.

In briefly describing this improved form, it would be stated that the bottom is identical with that of the Downing jar, and also it has the same outline for about one-third the distance up the sides. It is then gradually drawn in or made smaller, until it ends in a straight and comparatively narrow neck some four inches in length. On one side of this is the glass overflow, which is nearly twice as long as that on most forms. In the Clark jar one of the objects sought has been to have it so shaped that the currents of water would cause the good eggs as they came to the top, to be thrown inward and downward toward the center, while the lighter and poorer eggs would instead go to the surface, where they would be easily removed, or else would run off of their own accord. In other words, the idea was to perfect a jar for the handling of whitefish eggs which would be as nearly automatic in this respect as possible. The objection to the usual form of Chase or Downing jar has been the requirement of a considerable amount of labor for drawing off dead eggs, and also there is always the chance that quite a number of good eggs are unintentionally drawn out during the operation of using the siphon. However, the necessity of thus daily attending to the jars has never been questioned, for if not drawn off there was great danger of the fungus settling and mixing with the good eggs in the lower portions of the jar, thereby causing serious loss, and also inconvenience in handling. With these disadvantages in mind, it was set about to devise a new jar which had a current with a tendency to lift out the larger inferior eggs, or

at least make quite improbable the chance of their settling, and at the same time retain the good eggs. With such an improved



CLARK HATCHING JAR

form of jar it was thought that there would not only be a saving of eggs, but of labor as well. The result of study and investigation along these lines has been the formation of a jar as herein described.

The new jars were used throughout the winter hatching season at Detroit, and in operation they worked even better than had been anticipated, for the poor eggs separated very readily from the good, and it was only every three or four days that a siphon was put in to assist in completing the separation. This was not necessary by any means, but was merely done to somewhat hasten the final "cleaning up". An evidence that the use of a siphon was not required, and to show how nearly automatic this new form really is, it can be stated that one jar was never touched from the time the eggs were put in during November until a few days before they hatched the following April. As the eggs fungussed they rose to the top, and while some passed out, the most of them formed a mass which became attached to the tube near the upper end, and remained there until poked out with a feather just before hatching. The remaining eggs were of excellent quality, and it is firmly believed that this jar which was left untouched throughout the winter, produced more fry than did those which were frequently drawn off with a siphon. Of course the plan of leaving this mass of fungussed eggs in the jar for three months or more is not to be recommended in general practice, but it shows what can be done in the way of obtaining a jar which is virtually automatic. In actual use on an extensive scale, it is thought that the best plan would be to simply use a feather every few days in going over the eggs and break loose any bunches that might form, thus permitting them to pass out. Or if not yet fastened to the tube or neck of the jar, the slight additional aid occasioned by touching with a feather would be sufficient to cause the bunches of fungus to flow from the jar. Comparing this method of attending to the jars with that of daily drawing off with a siphon, it may readily be perceived that the saving of labor in favor of the improved form and method is worth careful consideration.

The increased length of the lip or overflow is thought to be of considerable advantage over other forms employed, as in using the Clark jar the water is thrown well over into the receiving

trough, with no trouble of running down on the outside, which difficulty has been sometimes experienced with the Downing or other jars. The only objection noted so far to the Clark jar is that its capacity is not quite as great as that of the other forms, but this can be remedied by having the size increased to hold at least 200,000 whitefish eggs, being careful to retain the same lines and proportions. A rough sketch of this jar drawn on a scale of one to four inches follows herewith.

DISCUSSION.

While reading his paper Mr. Clark made the following comments:

(1) Of course the current of water does that.

(2) I would say that the fungus or bunched eggs will not settle. That jar has run this winter, and there was not a single time where it was found that they would settle and go down in here (indicating)—a bunch of eggs.

(3) New jars were used throughout the winter, 625 of them.

(4) One jar (and that is the identical jar) was not touched at all. I mean there was nothing put in the jar whatever to remove any egg; neither siphon, feather, or anything else; nothing put in the jar for taking the eggs out.

(5) I would say the good eggs were from here down (indicating).

(6) This (indicating top of jar) will not be made any larger. It is proposed to make this (indicating) central portion an inch larger in diameter.

At the close of his paper, Mr. Clark said:

I would say, in addition to what I have read here in my notes, that there is no question at all but what that jar set up in a hatchery with whitefish, will simply run by itself. And in passing I wish to say this, that we have just lately found out, at least I think so, that on the whitefish matter—of course we have been hatching quite a good many years—but I think all these many years we have been working our whitefish eggs too much, even in any jar, I don't care whether it is the Chase jar, Downing jar, Meehan jar, or any other jar; we have been drawing off our eggs too much. I think we have lost good eggs, not any very

great per cent, but we have lost eggs by doing so. Too much attention has been paid to them. Here is a jar, with the fungus formed on there, and the foreman said that jar had stocked as good or better than any other jar we have. I think with that jar one man can take care of between 1500 and 2000 jars. We had in Detroit 1400 jars, and it is proposed this next winter that our labor during the day will be cut right square in two. (Applause.)

Mr. Fullerton: May I ask Mr. Clark a question? Would that apply to the white perch?

Mr. Clark: I would say that we did not try the white perch.

Mr. Fullerton: What is your judgment?

Mr. Clark: I will tell you better next year.

Mr. Fullerton: We do not hatch anything but white perch in Minnesota, and I would like to know.

Mr. Clark: I want to say this: that I am claiming this, that that is the only automatic jar.

Mr. Geer: Where can you get those jars?

Mr. Clark: You can probably have them made. There is no patent, and if anybody wants to use them they can probably have them made; there is no patent.

Mr. Thayer: Both jars will be made by C. Dolfing & Sons Company. And if this drawing Mr. Clark has is not satisfactory for printing in the report, I have no doubt one can be furnished in the office.

Mr. Clark: They have this same thing, and it will be necessary for us to have one in making the jar a little larger in diameter. It is very possible that this jar will be made on a mould. Heretofore the Downing jars and the others have not been made on a regular mould, and have not been uniform; some working a great deal better than others.

Prof. Smith: It seems to me this jar represents a tremendous advance in the methods of whitefish culture, if the jar accomplishes what Mr. Clark claims for it.

Mr. Downing: I would like to ask Mr. Clark what becomes of the eggs that flow over.

Mr. Clark: They flow into the trough.

Q. And then out into the tank?

Mr. Clark: Into the tank, if you please. In the Detroit plant the eggs flow into the tank and into the end. (Indicating.) It is the double battery system, and they flow to the other end, and air enters the tank at the cross section.

Q. Doesn't it ever plug any of them?

Mr. Clark: No reason why it should.

Q. No water can get down into your trough?

Mr. Clark: Then your hatchery is not run right. He should have another system for pumping his water out. What did you say was the reason of the eggs running in?

Mr. Downing: If the water should run down that would naturally create a suction.

Mr. Clark: And draw the eggs in a mass of fungus?

Mr. Downing: There would be no mass of fungus in your trough.

Mr. Clark: In the whitefish battery we have two systems. You have one here—Mr. Downing, I think has one here. You have got the Alpena system. In Detroit we have the double battery. All of you have either seen it or have read the description of it in the Fish Cultural Monthly. The water passes down into a trough. That trough does not feed your lower jars. This trough comes down to the other end. Your water is not going to run down; the eggs are not coming in to stop your faucet, because the eggs are down in your other trough.

Q. And do not pass down through the supply trough at all?

Mr. Clark: Not at all, unless they get too many. Of course they should be drawn out with a siphon. Those troughs should be cleaned out in every hatchery once in a while, according to how much there is in.

Mr. Carter: I should like to ask Mr. Clark about that tube. Is that the one with the three little feet at the bottom?

(Mr. Clark exhibits tube with the three feet at the bottom.)

Mr. Carter: I have used this at Swanton, Vermont, this same tube with these three little feet at the bottom (speaking of pike perch work). I always found that these feet checked the current of water, and the eggs are very apt to settle in the jar and not have very good movement. Have you ever had that trouble?

Mr. Clark: Caused on account of the feet?

Mr. Carter: Yes.

Mr. Clark: No sir, never heard of it.

Mr. Carter: Have you Mr. Downing?

Mr. Downing: My tube sits in a jar and a rubber tube goes down into it a sufficient distance, and the rubber tube is small enough so that there is a small circulation of air. And the business of the fish culturist is to move that tube a little, so that if any thing should catch on the teeth, it is liberated.

Mr. Carter: The reason I ask is, that in our jars at Swanton, we had those same tubes, with pike perch eggs. We had a great deal of trouble with the tube checking the flow of water, and the movement of the eggs in the jar. I had a new tube made, by taking off the little legs of the old ones and soldering a funnel on the opposite end. The tube was then self-centering; if the top of the jar was perfectly true, these tubes would center—we had no trouble at all—just dropped them in place and the funnel would center in the top of the jar. We used the McDonald jar, and we had no trouble. By driving a tapering piece of wood into the lower end of the tube, the latter was flared, giving the bottom tube a slightly bell shape and we had a very much better flow of water. This tube was always in the center; while I found with the others that the tube was not always in the center, that it sometimes hung one way and sometimes another. The only trouble with the funnel was we could not get the siphon down into the jar very easily—would have to

raise the funnel up. Finally I made the funnel itself in the shape of a cross, thus allowing apertures between the junction of the cross pieces for the insertion of the siphon.

Mr. Clark: Mr. President, may I ask Mr. Carter—you say a funnel in here? (indicating).

Mr. Carter: No, funnel at the top.

Mr. Clark: You mean a funnel shape?

Mr. Carter: An ordinary funnel, just a little larger, half an inch larger in circumference.

Mr. Clark: May I ask what it was for, to hold the tube up?

Mr. Carter: Yes. The water was allowed to flow with the little rubber tube, the funnel had half an inch of water, and the funnel was below that, so no air could get in at all?

Mr. Fullerton: Mr. Clark, is that the working size of your tube?

Mr. Clark: Yes sir, that is the tube itself, that was in use.

Mr. Fullerton: You put a rubber tube attachment on that?

Mr. Clark: The faucet is here (indicating) and the rubber tube goes inside here, below the water.

Mr. Fullerton: We work it the opposite. The rubber tube comes on the outside,—used the glass tubes.

Mr. Carter: The old jar at Swanton ran very unevenly, and for that reason the funnels did not always feed well, but where they did that, the funnels centered themselves, the tube being a little heavier sought its own center, and those jars worked beautifully.

Mr. Titcomb: I want to get at the difference between Mr. Clark and Mr. Johnson. In the first place, what does that tube cost?

Mr. Clark: Mr. Thayer, can you tell what these tubes cost by the thousand?

Mr. Thayer: I think about four and one-sixth cents.

Mr. Titcomb: The other costs about nine or ten. I wanted to get at the difference. Have you had any trouble with the tube not centering properly at the bottom?

Mr. Clark: I will ask Mr. Thayer.

Mr. Thayer: No sir, we have them feed properly.

Mr. Titcomb: That is for either pike perch or white fish?

Mr. Clark: Yes sir.

Mr. Titcomb: You never had this trouble that Mr. Carter refers to?

Mr. Clark: Yes, lots of it, but not caused by that tube.

Mr. Titcomb: I would like to have you explain to Mr. Carter what he wants.

Mr. Carter: I can explain to Mr. Clark that it is the tube. Where these three feet are, there is a checked flow of water, in which the eggs do not move. There is a V-shaped mass of eggs beginning at the bottom, where the feet are, and gradually extending to the top of the jar.

Mr. Clark: I would like to ask Mr. Carter, if he knows positively it is not some sediment of some grass that hangs on, that does that?

Mr. Carter: I know that.

Mr. Clark: You know that it is not. You know it is nothing but those feet?

Mr. Carter: I know it is nothing but those feet.

Mr. Clark: Then I have nothing to say.

Mr. Carter: I will ask Mr. Fullerton.

Mr. Fullerton: We had the same experience that Mr. Carter did, and threw the things away.

Mr. Clark: May I ask Mr. Fullerton, how he keeps his glass tube from the bottom.

Mr. Fullerton: Simply by cutting the rubber.

Mr. Clark: It hangs? Mr. Wires, how long ago did we use the tube you run here, and let it hang?

Mr. Wires: In 1883 or '84.

Mr. Carter: As I understand it, the rubber suspends the tube.

Mr. Clark: Yes.

Mr. Carter: Of course you couldn't suspend the tube without a perfect curve. What I say is, that the funnel centers the tube; if the top of the jar is perfectly round it holds the tube just exactly the right height, about a quarter of an inch from the bottom of the jar.

Mr. Titcomb: Mr. President, I am sorry that these gentlemen cannot find out what the trouble is with their tubes.

Mr. Clark: No trouble with my tube.

Mr. Titcomb: There seems to me quite a little evidence to confirm Mr. Carter's theory that it is not entirely satisfactory. I was trying to get at the trouble, because evidently it is a difference in the method of manipulation. Some have mentioned the use of glass tubes, so I will say in that connection that we use at some of the stations the glass tubes suspended, at shad station, where we find it desirable to use the McDonald jar with closed top, to propagate shad. At other times, in order to use the same jar with open top, we have the metallic ring, with pitcher nose to it; and the same glass tubes are used, by building a frame over the row of shad jars, simply a frame of wooden strips about three inches wide, suspended a little ways above the jar and held in place with wedges. In connection with the jars, and over each jar, there is a hole the size of the glass tube, or a trifle larger, through which the tube is inserted, and then the little rubber gasket which is used with the McDonald glass tube, is used on this wooden frame work, and that is the method of suspending the tubes, while operating a large number of open-top jars in the series.

Mr. Geer: Mr. President, may I ask Mr. Clark what the advantage of that tube is over the glass tube?

Mr. Clark: I am not saying that there is any, Mr. President, I am not. That tube has nothing to do with my paper. I will take it out. (Laughter.) This is the tube we use at the station, and it was perfectly satisfactory to us. Those that want to use glass tubes, why use glass tubes. Of course, you will all remember, if you have ever seen Mr. Chase's patent papers, they provide for a glass tube, way back in 1880, the first jar they invented, in the patent papers, provides for glass tubes. I suppose Mr. Fullerton has those same tubes.

Mr. Fullerton: Never saw one.

Mr. Clark: The original glass jar was invented by Mr. Chase, and that jar in the patent papers, I think provides for a glass tube. Now, all these others have been taken from that. Mr. Chase had on his glass tubes the little feet here, but of course they were not as thin. The thing that I feel a little funny about is how can a very thin thing like that stop the flow of water, to make trouble with the eggs. That is the only point. It seems to me it must be something else that makes that, with the pike perch, I should say—Mr. Thayer is more familiar I should think it was the chunks of fungus and the eggs, isn't that it?

Mr. Thayer: That is all we found.

Mr. Clark: And does not effect the eggs so that they shoot up here and there. It is the mass of fungus in there with your pure eggs. But if the glass tube is what one man wants, let him have it. One man may use tin, another lead, or something else. In the Detroit hatchery, we used to use lead—isn't that right Mr. Bower?

Mr. Bower: Yes, sir.

SOME OBSERVATIONS ON EUROPEAN FISHERIES AND FISH CULTURE*

BY HUGH M. SMITH,

Deputy U. S. Commissioner of Fisheries

Marine culture.

The cultivation of marine fishes in Europe is on a comparatively small scale. As it is a form of pisciculture which private individuals are not willing to undertake, and as government work of this kind is the exception rather than the rule in Europe, but little attention has been given to the increase of strictly salt-water species. Furthermore, there is considerable skepticism among biologists and fishery authorities as to the value of fish culture as applied to the sea, and the limited work now carried on is far from being regarded favorably.

The most extensive and celebrated of the European marine fish-cultural establishments is that near Arendal, in southern Norway. This was started in 1884 under Captain G. M. Dannevig, who was thus a pioneer in practical marine fish culture; this work began in the United States in 1886, and was to a great extent influenced by the Norwegian methods. I saw manuscript letters written by Professor Baird to Captain Dannevig in 1884-6 asking for particulars as to the apparatus and methods of cod culture. We have now developed other methods and appliances, but from what I was able to observe I am inclined to believe that the old Norwegian methods are decidedly better in some respects. The hatchery operations have of late years been addressed exclusively to the cod, and have been quite extensive, the number of fry turned out in the past fifteen years being considerably more than 3,000 millions. The hatchery was originally constructed by the Society for the Promotion of the Norwegian Fisheries, but is now maintained by the general government, which makes an annual grant of 10,000 kroner ($2,500), recently reduced to 7,500 kroner ($1,875).

Following are the salient features of Norwegian cod culture:

(1) The brood fish are bought from the market fishermen

*Based on personal inquiries in 1905.

and are kept in a large artificial pond high above the level of the sea. The pond accommodates 1,500 cod averaging 7 or 8 pounds in weight; during the season of 1905 there were 500 fish on hand, of which only one-tenth were males. The pond has a sheet-iron roof, and no direct light reaches it. It is 15 feet deep, with a false bottom of wooden slats, through which the debris passes to the real bottom, whence it may be drawn off by opening pipes.

(2) The brood cod are fed regularly from the outset and remain in sound condition, although they lose weight. The best food in lean fresh herring, but fat herring, salt herring, and other fish may be used. The darkened pond prevents the loss of sight which is so common in fish confined in shallow live-cars in the open air.

(3) The characteristic and very important point in the operations is that the cod are not handled at all, but are allowed to spawn naturally. Spawning takes place from 9 p. m. to 1 a. m., and practically all the eggs are fertilized. The eggs come to the surface, and pass out of the pond through a broad, shallow overflow into a flume which leads to a special house, where the bottom of the flume is covered with silk-mesh screen on which the eggs are left as the water passes through. The eggs are gently scooped up and transferred to buckets or tubs of salt water the density of which is gradually reduced, so that the eggs will sink while the oily refuse remains at the surface and may be poured off. The eggs are next measured, 450,000 being allowed to a liter (our figures are 337,000 to a quart, or about 346,000 to a liter—a discrepancy of 104,000, or 33 per cent, which the fish culturists must explain), and are then placed in the hatching boxes, 1 to 1½ liters to a box. The largest number of eggs taken in one season was 1,440,000,000; in 1905 the number was 363,000,000, an average of something over 800,000 per fish.

(4) The hatching apparatus is essentially the same as our automatic tidal box, most of the differences in construction being in favor of ours, in my judgment, although of course Captain Dannevig is firmly convinced that his is the most effective. The hatching season begins in February and continues till May. The maximum number of eggs that may be incubated at one

time is 200,000,000, but more than 400,000,000 may be handled in a season; and, as a matter of fact, 412,000,000 fry were planted one year. The average cost of the entire operations is less than one cent per 1,000 fry planted. The water density varies considerably, and exerts an influence on the work. The maximum density is 1.027, but sometimes large quantities of fresh water are discharged from the Baltic Sea, and the density has fallen as low as 1.014. This is fatal to the success of the hatchery, as the eggs will not float and can not be gotten out of the spawning pond. The young are kept in the hatching boxes four or five days before planting; by that time they have become much stronger and hardier than when a day or two old.

(5) Captain Dannevig has established the fact that individual cod spawn annually. He has kept brood fish in ponds five years, and has gotten eggs from them each season. The fish thus kept at the station, being fed regularly, remain in good condition and their ovarian development seems to be greater than in wild fish. Captain Dannevig says there is as much difference between them and wild cod as between a Yorkshire hog and a wild boar. Immense numbers of eggs have been yielded by some of these domesticated cod.

Lobsters.

The Norwegian lobster fishery is more important than that of any other European country, although the abundance of lobsters has greatly decreased in recent years. Many years ago the hatching of lobsters was carried on at Arendal in conjunction with cod hatching, Captain Dannevig having been the pioneer in the artificial propagation of lobsters. For a long time lobster hatching has been abandoned because of the absence of appreciable results and the general unpopularity of marine culture; and only experimental work, in the line of rearing, has been carried on. The experiments have been in charge of Dr. Appellöf, of the Bergen Museum, who informed me that he had got some rather promising results and will continue the work on a larger scale. He does not attempt to hatch the lobsters, but keeps the brood females in live boxes and lets them hatch their own eggs. The larvae are collected and transferred

to rearing boxes; these are about 2 feet square and 3 feet deep, with a latticed top and with sides and bottom formed of a fine, strong, black serim. Such boxes, which will accommodate 8,000 to 10,000 larvae, are moored in rows between rocks or stakes in protected bays, where there is wave movement but no heavy seas. It is reported that owing perhaps to the lower temperature of the water the development of the larvae is apparently considerably slower than in America. My personal opinion is that the absence of a well marked and sustained circulation within the boxes decidedly impairs the chances of success.

Sturgeon and Shad.

The sturgeon fisheries of Russia are more important than those of any other country; and it is only in Russia that sturgeon cultivation is carried on. Mr. Borodine, the Russian chief specialist in fish culture, told me that several million sturgeon are now hatched annually on the Caspian Sea, the species being the one he recently described. There is difficulty in holding the young for any length of time. With other species the great drawback encountered is the same which we have to contend with, the inability to find ripe fish.

In connection with Mr. Leary's efforts to acclimatize shad (and other fishes) in a salt-water lake in Texas, I may mention the existence, in some of the Italian fresh-water lakes, of a naturally landlocked shad (*Alosa vulgaris* var. *lacustris*). Mr. G. Besana, of Milan, the gentleman who has achieved such marked success in the acclimatization of our black bass and sunfish, has the cultivation of this lake shad under consideration, and has been making some observations on the fish's habits preliminary thereto. It reaches a length of a foot, but the average size is several inches less; the anadromous form is much larger, comparing very favorably with our shad in size. The lake fish is very palatable, and is said to be superior to the seagoing form in food value. The spawning period is the first half of June, and the eggs are deposited mostly in the evening, although there is a secondary spawning time about four or five in the morning. The fish come from the deep waters of the lake to spawn, and then make a loud splashing noise about the shores. For three years immense numbers have been dying in

May and June; the fish are well-nourished and apparently sound, and the cause of the mortality is not known, although Myxosporidia have been suspected.

Salmon.

The cultivation of the Atlantic salmon in Norway is conducted at several large government stations, and the work is very popular. More dependence, however, is placed on legislation than on artificial propagation to maintain the supply; a new law, which went into effect in 1905, has a prominent feature in a close-time on net fishing from Friday to Monday. As is well known, Norway is visited by many anglers from England and other European countries, and the best salmon streams are in great demand. For example, on the Lardal River the land owners, mostly peasants, now receive $10,000 to $12,000 annually for the angling privileges, and obtain also many indirect benefits. In northern Norway there are valuable salmon waters that as yet are practically untouched, owing to their remoteness and the absence of markets; but along the western and southern coasts depletion has occurred and replenishment has not been effected. In these circumstances, the Society for the Promotion of the Norwegian Fisheries—a semi-official organization—is considering the introduction of the humpback salmon of our Pacific coast, and has been in correspondence with the fishery department of the State of Washington. I was questioned in regard to the game and food qualities of the humpback, and was informed that probably 500,000 eggs would be obtained this season as the initial step in the attempted acclimatization of the species. The physical characters of the Norwegian coast are very similar to those of Alaska, where the humback abounds, and the introduction of this fish should prove successful.

Fish Transportation.

In Vienna I saw a number of demonstrations of the fish-transporting device, patented under the name "Hydrobion", about which there have been several notices in the American press during the past few years. Any form of vessel may be used, but the standard furnished by the inventor is an elliptical

tub 3½ feet high, 2½ feet long, and 15 to 18 inches wide. The essential feature of the apparatus is a small cylinder containing oxygen under a pressure of 120 atmospheres, the escape of the oxygen being regulated by a valve. The cylinder is fastened to the bottom or lower side of the vessel and the oxygen comes off in small bubbles. The cylinder is made in five sizes, adapted to the size of vessel used, the length of the journey, and the number of fish to be transported. For any cylinder, the escape valve may be so adjusted that the liberation of the oxygen will continue during the entire anticipated length of the trip. It is claimed by the inventor that a tank of two-year-old trout, say 40 to 50 fish, will carry without loss in moderate weather for 48 hours. The cost of the outfit, with five cylinders, is $100, at which price there must be a very handsome profit.

The fishes I saw experimented with were brown trout up to a foot in length and carp up to a foot and a half in length. The tanks were in the open air, and the temperature of the air was 80° to 85° F. Both lots of fish seemed to be suffering, as they came to the surface repeatedly and showed labored respiration. A thick scum continued to form all over the surface, and had to be removed by an attendant from time to time; whether this was due to the green, uncoated tanks or to the water I do not know. My impression was that perhaps the oxygen reached the fish in a too concentrated state for their needs. An Italian fishculturist told me that he had found the apparatus useful and efficient in transporting bass and sunfish; and that the cylinders could be recharged (in Rome, for example) at an insignificant cost. This same gentleman had recently met a Berlin engineer who claimed to have perfected an apparatus which, by liberating ozone in the water, permits the transportation of fish in remarkably small quantities of water. Thus trout eggs may be carried in a vessel containing only as much water by bulk as trout, while carp may be safely transported in a vessel containing 18 per cent fish and only 18 per cent water. The inventor has hopes of being able to carry live salmon from America to Europe on the regular ocean steamers.

Austrian trout-breeding establishments.

In conjunction with the Fishery Congress in Vienna, visits were made to a number of private trout-breeding establishments in lower Austria. These visits proved very interesting, enjoyable, and profitable to me; and I will venture to tell you something about the hatcheries, their methods, and their products.

Here, as at most other places in Austria and Germany, the American trouts are handled, and give very satisfactory results. The rainbow trout is the most general favorite, owing to its hardiness, rapid growth, and all-round good qualities.

I was very strongly impressed with the methods of feeding in vogue at all of these stations, although I have not sufficient knowledge of practical fisheulture to judge whether the Austrian practices are unknown or unused among us.

In the first place, great stress is laid on the value of natural food for young trout, and much attention is devoted to its production and administration. Certain ponds, together with ditches and moats, are kept well stocked with water plants, and such waters are used as reservoirs for copepods, which are collected with fine-meshed nets as needed. In addition to this, piles of compost are placed at intervals around the borders of the rearing ponds, the compost being the material taken from the bottoms of ponds and left to dry on the shores for several years. The use of compost in this way is based on the theory that there is secured an abundant development of bacteria which serve as food for the copepods. At one station a very shallow pond covering about an acre had been drained and when dry had been thickly sown with peas and grass, which growth when 6 to 12 inches high was killed by flooding the pond. It was expected that in a short time decomposition of the vegetable matter would begin and bacteria and copepods would appear in large numbers; then young trout would be introduced. This was an initial experiment, and some of the visiting fish culturists with whom I talked expressed doubt as to the rationale of the procedure.

Another food in general use was found to be the salted eggs of the cod. These come from Norway in barrels holding several hundred pounds, and are prepared primarily for use as bait in

the French sardine fishery. The eggs are soaked in fresh water before using, and their small size makes them available for the youngest trout. In feeding, care is exercised to prevent the young trout from gorging; in other words, the food is given in small quantities, and the feeding periods are prolonged. The manner of automatically administering food to the young was new to me, but may be well known to some of the members of the society. In the case of copepods, ordinary terra-cotta flower pots are suspended from a rod supported by two stakes driven in the bottom of a pond or sluice, the top of the pots being an inch or two above the surface of the water; in addition to the hole in the bottom of the pots, three to five holes are made in the side near the base. When a dipperful of copepods is put into one of these pots, the tiny creatures gradually pass out and are seized by the waiting trout. One pot will thus be a reservoir which continues to discharge its contents for 20 minutes to one hour.

Cod eggs are administered in a similar way. They are mixed with water in large wooden or metal buckets or tubs in the bottom of which are several circular holes into which short pieces of rubber tubing are inserted, the size of the holes and tubing being such as to secure a small, steady outflow. These vessels may rest on a plank or be suspended from a stake, the ends of the tubes a few inches above the surface of the pond; and are set near the inflow, so that the food will be scattered by the current. Some of these feeding buckets which I saw in operation will discharge for an hour or more without alteration.

Mr. Franz von Pirko, the president of the Austrian Fishery Society, has a large estate at Pottenbrunn, and on it is an excellent trout-rearing plant. An abundant—practically unlimited—supply of fine spring water enables him to maintain many ponds and sluices, and to provide plenty of room and natural food for the growing trout. At present the establishment comprises 20 nursery and rearing ponds and 24 so-called nursery ditches, with a total area of 38,000 square meters, in addition to which there are 12 kilometers of spring brooks stocked with fish. The nursery ditches (Brutstreckgräben) are very narrow, shallow water-ways, with considerable current and well supplied with growing plants, in which the trout are placed

immediately after the absorption of the yolk-sac. The fish are not allowed to roam freely in these ditches, but are confined in live-cars 5 to 7 feet long in which there are natural conditions —that is, plants, sandy bottom, and hiding places.

The principal species handled are *Salmo fario, Salmo irideus,* and *Salvelinus fontinalis.* The average yearly egg-take of late has been 200,000 eggs of the native trout, 100,000 eggs of the American brook trout, and 100,000 eggs of the rainbow trout. The loss during incubation is 10 to 15 per cent and during the yolk-sac period 5 to 8 per cent, so that the annual output is about 300,000 fish for planting in the rearing ditches. The annual sales of market fish are now about 4,000 pounds, for which 70 and 75 cents a pound are received from dealers, the retail consumer paying from 80 cents to $1.00 a pound.

According to a descriptive booklet issued by Mr. von Pirko, the aims of the establishment are (1) to produce healthy brood fish in natural waters; (2) to produce healthy well-colored yearling fry for market, the method of their rearing based upon exact knowledge of their habits and necessities; and (3) to produce rapidly growing edible trout in running water and in ponds by consideration of all the factors of natural existence and food.

At Wagram is a rather extensive plant, established in 1868, forming part of a large estate and being sub-let to a practical fish culturist. When I entered the grounds, it was difficult to realize that I was not in America, for practically every pond contained American trouts, as shown by the conspicuous signs. Here I saw *Salvelinus fontinalis, Salmo irideus, Salmo clarkei* and *Salmo gairdneri.* Among the fish on hand June 10 were 20,000 yearling brook trout, 50,000 yearling rainbow trout, and 300 large breeders, 400 two-year-old black-spotted trout in fine condition (the original stock from Jaffe at Sandport), and several thousand excellent steelheads about two years old, together with some hybrid steelheads and native brook trout *(Salmo fario).* The proprietor sells some fish for food in the Vienna market, but his principal business is in yearlings for stocking purposes; for such fish the prevailing price is $28 per thousand.

The conclusions I reached after inspecting these and various other establishments were that some of the practices are worthy

of adoption by us, but that the methods as a whole are not adapted to the wholesale operations of our hatcheries.

DISCUSSION.

During the reading of his paper Dr. Smith made the following comments:

1. There was practically an unlimited supply of fine spring water.

2. Referring to figures, Dr. Smith said: These are very small figures, compared to American figures.

Referring to the size of the pond, President Birge said: That is about 38 hectares.

Dr. Smith said: 38,000 square meters.

President: That is a pretty large area.

Dr. Smith: He has an immense estate there.

President: That is a hundred acres to a pond.

Mr. Smith: I may say that this man is wealthy, does not have to engage in this business; it is a pastime with him. Nevertheless, he sends fish to the market.

3. This method of transporting yearling fish in relatively small portions of water is perhaps worthy of consideration by this society. The Japanese are most adept in fish matters and are able to carry gold fish and other delicate forms of fish, practically without any water.

I have seen shallow tubs of gold fish carried on the shoulders of a Japanese for a distance of more than a mile in broiling sun, with no covers over the tubs and the fish at no time submerged. The fishes were moist, squirming all the time and got plenty of oxygen. Whereas, if those fish had been fewer in number, and the water more abundant, and the water had become superheated by the long distance in the broiling sun, the chances are, the fishes would have died. I may say that same methods have been employed by one of the leading Japanese gold fish culturists in transporting gold fish to this country. He recently arrived in New York, and Dr. Bean told me that was the method he em-

ployed. Does Dr. Bean remember how many fishes he started with and how many he lost?

Dr. Bean: He had a three weeks sea journey, and nearly a full week of rail journey, and lost only 30 per cent. He brought 800 alive to New York.

Dr. Smith: These were adult fish?

Dr. Bean: A large percentage of them were adult fish—about one-third of them were adult.

Referring to the cod fisheries, Dr. Smith said: And those of our members who are at all interested in cod culture, as practiced on the New England Coast, will perhaps find something suggestive here.

4. Just one moment more, that I may say something about the Norwegian method in regard to our work at Woods' Hole. At Woods' Hole we had a pond, and Mr. Titcomb gave instructions to have this put in shape so that it could be used as a spawning pen. The conditions were entirely unsuitable and unfavorable, but the results are such that we hope to provide more adequate facilities before long.

5. That is all I have to say, and I thank you for your attention. (Great Applause.)

President: Is there any further discussion of Dr. Smith's paper?

Mr. Clark: In the fore part of Dr. Smith's paper, he speaks, I think, something about putting polyps or something of that kind in the bottom of the pond at Christiana. We tried a little experiment this year of spreading manure on the bottom of the pond. Of course, I am not prepared to say very much about this, as the experiment has not been continued. But the pond certainly had more life this spring than it had last, that is sure, more food life for the bass, and our bass in that pond were in excellent shape, and very large—our young bass, and I believe that if something of that kind should be done, spreading manures or something of that kind, on the bottom of the pond, more food could be procured for our spawn fishes.

Mr. Green: I may state that we tried the same experiment at White Plains, not only with manure, but muck. While, of course these experiments have not been extensively carried on, so far we believe muck is better than manure; we can see quite a growth of moss and chara and plants of that kind.

Mr. Clark: I do not think that the manure which we spread increased the vegetation. I think it was a little lighter this year than last, the moss was a little thinner in the pond than last year. I think there is something about manure that produces more life.

President: Any further discussion of Dr. Smith's paper? My recollection is that the Germans followed that method of putting manure in the bottom of ponds for a good while, in raising daphnias, copepodas and things of that sort.

Mr. Lydell: He speaks in that paper, in regard to spreading it around on his pond the following year, and that it is throwing away a very valuable product. We take tons of that stuff out of our ponds and throw it away. According to that paper it is a very valuable thing.

Mr. Clark: It is absolutely necessary to rake and clear it up in order to get our bass fingerlings out, but this year we threw it over—the balance in one pond—we have not started on the other pond—and after it sort of settled down and got in such condition that we could, we spread it out and filled the pond up, instead of throwing it away.

Professor A. D. Mead, Providence, R. I.: I am interested in one other point, the Japanese method of aeration of water. I have been trying to keep alive marine animals of various kinds. My idea is to have the water shallow, rather two inches than two feet. The relative amount of surface to the volume of water, seems to be the important thing. I have been able to keep young lobsters for several months without change of water in a shallow dish with large surface.

Professor Smith: This suggests a change in the shape of our fish transportating cans. It seems to me that for some purposes, our cans are too deep and the fishes at the bottom suffer.

President: I think that is true. But when you are transporting things, you have got to consider motion etc., the amount of water motion that shallow water would get. It is certainly true that you have to keep the water aerated in these cans to keep the fish alive for any time.

Dr. Bean: I happened to see the large collection of gold fish which were brought by a Japanese from Japan to New York early in this month, after a sea journey, as I remarked, of nearly three weeks, and a land journey of about another week, in a very shallow and rather wide Japanese tub. I was surprised when I went down into the laboratory in New York and saw these things and realized what he had accomplished. He had brought eighty percent of his fish from Japan to New York, apparently in good health, and they continued in good health, that is to say, he lost almost none of them after he arrived in New York, although the weather was very warm. Now, he certainly did not have more than three or four inches of water in his tubs. The backs of the fish were out of the water, and as far as I could learn, he did not aerate the water; he had no means of aerating the water on the journey, and told me that he had great difficulty in getting a change of water on the way. It would seem, then, as if there was something in favor of the wide open shallow tub for fish transportation. I do not think it is practical with us, with our great amount of transportation, although he did the same thing, brought them in baggage cars from Seattle to New York in these tubs.

President: There is no question but if we wish to keep fry fish, we put them in a sink and keep them moist. If you keep a little water on them, so that they are kept wet, but not under water, they will live almost indefinitely.

Mr. Carter: Dr. Smith has spoken of the method of handling the cod; of having cod spawn naturally and of drawing the eggs from the surface of the water gradually. I persume that the fish spawn from day to day. With the pike perch, the great trouble seems to me to be that you have to take all the eggs from the fish at the time of stripping, and in reality a small percentage only are ready to be taken. In the waters inhabited by them

these fish deposit a few one day and a few the next. I have seen pike perch spawn in the bottom of our crates. It occurred to me if the crates could be arranged so that the fish could spawn naturally—simply elevate the pen in which the fish are held in some way, introduce the water at one end, at the top, and draw it off gradually from the bottom, let the fish spawn naturally, and collect the eggs from the troughs, that we might get a larger percentage of good eggs than now.

President: You would run onto the practical difficulty of separating the eggs from below, of course, which they avoid in the case of the trout egg.

Mr. Carter: You mean in drawing it from the bottom of the tank. The water would have to be introduced in vats through strainers, of course, clear water. There might be something of that sort. The idea occurred to me; I want to think it over.

SOME PRACTICAL DIFFICULTIES IN THE WAY OF FISH CULTURE

BY TARLETON H. BEAN, STATE FISH CULTURIST OF NEW YORK.

I do not intend to read a paper, but rather to place before you an outline of some of the difficulties which have been met in the fish culture work of New York during the last year and a half, or since about the 10th of January, 1906.

I have not been able to do anything more than make a synopsis of the practical troubles and the menace, which we have, to some extent, overcome; and in some other cases the reverse has been true, we have been overcome by the difficulties. In the first place I noticed here that an excess of air in the water supply has given considerable trouble at two stations. One at Muskellunge station, at Bemis Point, the other at the Catskill hatchery, on the Hudson River. At Bemis Point, Mr. Brown had difficulty in keeping the eggs in jars. He hatches them there in jars now—and also in keeping the fry in the rearing boxes. He did not entirely overcome it at the Catskill station. Now, I must tell you why he did not. In the first place, the water supply at Bemis Point is artesian, the water comes into the hatcheries through a four-inch pipe or six-inch pipe and there was no practical means of meandering it before introducing it in the distributing box in the hatchery. He had to meet the difficulty as best he could. I advised him to meander the water, if he could, but after having done so, I learned that Mr. Charles H. Wallace had adopted another plan; in fact he had two ways of overcoming this excess of air in the water supply. The water supply there was from the city. He put a fine screen in the supply pipe, just a little distance from the receiving box in the hatchery; but the effect of the screen was to remove the bubbles of air, break them up to such an extent that it no longer was able to carry out the eggs from the jars; and I told Mr. Brown about that method, and I know perfectly well that he can't introduce it successfully at Bemis Point in hatching the muskellunge eggs. Mr. Wallace hit upon another plan, which, of course, is a modification of the meandering system, that is to

say, he allowed the water to come into one pond, and pass to another one before it came into the hatchery pipes,—and accomplished exactly the same purpose.

We have had a great deal of trouble on the score of dry weather at some of the trout stations, and I need not go into the details about that with you.

Excess heat has also caused considerable difficulty, particularly in trout streams which are very rocky. The intensely hot air has caused the rocks to warm up, and to retain the heat, and thereby communicate it to the surrounding water to such an extent that a great many trout have been killed, simply by the excessive heat.

Another practical trouble which affected the shad work during the past season must have been observed by all who have been engaged in that work, and that was the very low temperature of the water early in the season and continuing until say, up to the 1st of June.

At one of our stations, we have another practical difficulty in the shape of a grist mill, which stirs up and uses most of the water supply of a good trout brook, during about one-half of each day, so that we can get at most only about a ten inch pipe flow of water during the dry season of the summer, when the mill is in operation. We do not know at present any good way to get rid of that difficulty, except that we have another string to our bow; fortunately there is on the other side of that station and alongside of our own property a very much larger creek, a creek about 50 feet wide and over forty miles long, which has a succession of rapids in which we could easily, by means of a dam, get a new supply. We could get one from that stream which would flood two hundred acres of ponds, if we had that amount.

President: Couldn't you get the state of New York to buy the mill?

Mr. Bean: The owner of that mill is a man who has considerable property, and would not sell at any price? It could be condemned. In fact, that leads me to another heading—the scarcity of good hatchery sites. It is perfectly astonishing, even to the practical fish culturists, to note the very great number of

places in any state—we will say almost any state—which look good at the outset for trout culture—especially for trout culture—but which turn out to be deficient, because there isn't water enough; and in some cases too much of the water is used for industrial purposes. That is true in New York, and in order to complicate matters still more all over the country, this natural scarcity of good hatchery sites is supplemented by a natural desire on the part of certain individuals to force the location of a hatchery into some site known to be unsuitable for fish culture purposes but quite suitable for booming real estate. This is a practical difficulty which we cannot pass over lightly.

In the transportation of fish in New York, there has been a great deal of trouble through defective car service. The state has only one car—and I presume this will apply to other states besides New York—the state has one car, which is not a modern car by any means, that is to say, it will simply carry fish in cans, and has an ice box—has no means of circulating the water, or of regulating the temperature. And such car, while it has its uses, of course,—is not to be despised by any means—is a little bit too inadequate, it seems to me, for any great state to use at the present time.

Then there has been considerable difficulty of late in securing railroad transportation. This is not a general difficulty, but we fear it is going to become general, through the opposition to railroad management at present. We fear at least it will become more serious than it has been so far.

The losses of eggs in transportation sometimes have been rather large and almost unaccountable, as well as the losses of fish: and in some cases we have found we would be able to trace the losses of eggs to defects either in the system of packing or in the kind of material used in the egg cases. Very often we know that moss has been used which is not thoroughly washed and prepared for the journey, and this moss, as you all know, in some instances, carries bacteria which introduce disease into a stream. We have had such cases within the last year and a half, and we have to watch the matter very closely on that account. In other words, we have to be very careful from whom we buy goods and crates, and insist upon it that they shall be properly

packed, not only in regard to the methods of packing, but the material used for the transportation of the eggs.

Improper food has caused a good deal of loss. Impure food has been even a more active cause of loss of fish—and by impure food, I mean liver, for instance, which has been practically spoiled or soured in some way. You may say that these things can all be avoided, which is very true, and I hope they will be, in the course of time. Accidents will happen in the very best of families, and where food may be obtained one day, where service has been reliable up to a certain point, and you find something has been sent which is not up to the standard, but which you must use for want of something better—you will see that the complication is not an easy one.

Pollutions of the waters of various kinds, from the acids proceeding from wood alcohol factories and the sawdust from saw mills, have continued to give us more or less trouble.

Another very practical difficulty arose near Tivoli, during the present shad season. We were counting upon a late take of shad eggs near Tivoli, in a little channel, but when the men got in there they found that someone had dumped cinders to such an extent that the shad had deserted the channel, and they could not pull the nets through it.

We had another case near one of the stations. The owner of some stock, horses and sheep, allowed dead animals to be placed in one of the streams, which we were expecting to use, and we had a great deal of trouble with that man, and we finally had to apply even to the state health board, before we could compel him to take his dead horses and sheep out of that stream.

There have been great difficulties in collecting eggs. Last fall, bad weather interfered very greatly indeed with egg collection, especially on some of the great lakes. We lost several cases of whitefish eggs at one time through nobody's fault, but just because the weather was so stormy that it was impossible to save them. We have even had violence offered, in some cases, to the men who were engaged in taking eggs. On Long Island, a man was assaulted while in the act of collecting smelt eggs near Center Port. This does not often happen, though it has happened to us in Canandaigua, and I have been told by one of the members that when his father first began the work of shad hatching

he was obliged to lie on the bank near the box until the shad hatched, with a pistol in his hand, to protect it.

Another difficulty in our egg collection has been either an excess or scarcity of male fish at the proper time, and still another has been the unexpected movement of certain fish as, for instance, the smelt. The habits of the smelt have become pretty well known, on Long Island especially, where we take something like a hundred millions early in the spring; and yet, the men best acquainted with the habits of the smelt have been at a loss sometimes to know where to find the fish. Usually they run up into the little creeks, not far from salt water, and deposit their eggs in the sand and gravel; but occasionally they will forsake a stream which has been a favorite spawning ground for them, for some unknown reason, and then they must be sought for; and it is not very easy work to hunt for smelt at night, because they spawn only at night, and leave the streams just at the break of day.

We have had also a great deal of trouble because of the lack of information about the results of work. Every fish culturist wants to know whether his work is successful or not, and in our state we try through the officers of the rod and gun clubs and the fish and game leagues, to discover whether or not we succeed in establishing a species in given bodies of water.

Just to illustrate how hard it is to obtain satisfactory information, I will tell you an experience, without mentioning any names. A lake in western New York was stocked with pike perch, at the request of a certain rod and gun club. The president of that club, a man of considerable intelligence, and supposed to be well acquainted with common fish at least, informed the boys that they were taking large numbers of young pike perch in one body of water which he had stocked and in which he was especially interested. He was asked to send a specimen, which he said he would do; he was told how to preserve it, and preserved it. It came to the desk of the fish culturist, and when the package was opened it was found to be a sunfish. So that we do not know now whether we have succeeded in establishing the pike perch in that lake or not.

Another illustration of the same difficulty occurred in the central portion of New York. It was said that young pike perch

were running up a certain creek in the spring in enormous shoals, and that they were being attacked with a peculiar eye disease, and losing their eyes. Of course that called out the fish culturist, and to his utter astonishment, he found that the information, which had come from one of the best fishermen in the state, and one of the best fish culturists in the state, too, was entirely erroneous. The fish were not pike perch at all, but trout perch, the little *percopsis guttatus*, which you know so well, and every bit of information which had come to the office about the big pike perch eating the little pike perch, and the big fish coming in, and the eye disease, related to this trout perch. We did discover afterwards that the yellow perch and the pike perch had been attacked by this same disease, and we don't know now, what this disease is which carried away, I am safe in saying, tens of thousands of fish measuring from three to four inches. We know absolutely nothing about it, except what Dr. Marsh of the Fisheries' Bureau could tell us, which was very little. He has not been able to isolate the bacillus and could only do so through field work. He has not been able to do the field work, and the disease is now in progress; it is very fatal. I have that as one of my captions here. The little fish run up the creeks at Constantia from Lake Oneida, beginning in the month of May and continuing through the summer. In two or three days after their appearance in the small creeks, it will be noticed that one of the eyes, or perhaps both of the eyes, is inflamed and intensely red. A few days later it will be seen that the eye has been removed entirely from the skull. Now this is not popeye. I know popeye as well as I know a piece of bread when I see it; it is not popeye. As Mr. Marsh says, it is an entirely new disease, of bacterial origin. Sometimes both eyes are destroyed in this way in a very few days; and this will happen to bass, yellow perch and any other small fish that may be in the creeks at that time. It is a very fatal disease.

President: How long does it last?

Dr. Bean: Lasts all summer. It is well worth attention.

Gentlemen, I do not intend to read any more of this paper, because you will see it in much better form later on, but I would like to mention the other points. This lack of information about

the results of stocking is supplemented by the further lack of information about the natural food of the regions to be stocked, and that, of course, is an old story. Also, about the kind of fish that inhabit the waters, we want to stock.

We have had a great deal of difficulty from illegal fishing, that is to say, illegal netting, which deprives us, we are sure, of a great many male fish in Canandaigua, Placid, and some other inland lakes. Generally the whitefish netters get in their work before we get on the field, and they take the males, because the males run first, and in that way, we have been unable to get sufficient milt. Hundreds and hundreds of ripe females have been lost for want of milt.

Of course there have been fish parasites, especially the common parasite, which you all know as the gill louse parasite, which has affected the brooktrout in the Adirondacks and by unfortunate chance has been introduced into other waters, by the bringing of adult fish from the Adirondacks into other waters. You may say, of course, that the messenger should know better than to transport fish afflicted with gill infection, but we are dealing with a fact and not a theory. As you know, the parasite becomes firmly attached to the gills of brook trout, and whenever it has become attached in sufficient numbers it invariably kills the fish when they are two or three years old. It does not attack young fish at all. Now the only remedy that has been suggested for this parasite is one that has to deal with the young form of the parasite, that is the swimming larvae. The remedy is a different swimming fish, say for instance like the fresh water killifish, or the top swimmer, any little fish that will swim at the surface, such as the sheep's head killifish or any fish of that kind which will live in the cold trout waters will answer the purpose of feeding on the swimming larvae so that there will not be enough to kill any fish, and thereby the disease is kept in check.

Fish diseases. We have had a number of very fatal diseases to overcome, and we have been able, fortunately, to handle some of them. One is the well known ulcer disease or furunculosis of the brown trout, which prevailed to such an extent at one of our stations as to carry off all the brood stock. That has been en-

tirely overcome at that station by a total change of the water supply. In no other way could we do it, because we did not control the entire stream. You know what it is, of course. Boils break out all over the surface of the body. The disease is of bacterial origin, and originates in streams which have become polluted, especially by the washings from manure heaps, barnyard manure, and even from other sources, water closets etc., draining into the stream, bringing on these conditions on which the bacteria thrive. But we have now cut out that stream entirely, and by the introduction of spring water, we are able to raise brown trout just as well at the station as we ever were. Fortunately the rainbow trout is immune to this disease, and in order to deal with it on Long Island, we are introducing rainbow trout to replace the brown trout as far as possible.

I have still several other points, but the time is passing and I will not enter into them at present. I thank you gentlemen for your attention. (Applause.)

DISCUSSION.

Mr. A. Kelly Evans: Might I ask Dr. Bean if he knows of the success attending the efforts of, I think, the Rogers' process, in looking after the harmful waste in the pulp mills?

Dr. Bean: Mr. Chairman, I have not been able to give that matter any attention at all, for two reasons. In the first place, that whole subject of pollution is in the hands of the chief fish and game protector, Mr. Burnham, who has gone into it very thoroughly indeed, and has compiled an immense amount of information on that subject, and has instituted a number of suits against mills and factories which are polluting the water. I do not know what the Rogers' system is at all. I know what some of the foreign countries do in the way of utilization of sewage and rendering waste harmless, but I do not know anything about that system.

Mr. Evans: The reason I asked is that we in Ontario and Quebec are face to face with a very serious problem, the export or non-export of pulp. The provinces of Ontario and Quebec possess a great majority of the pulp forests of the continent now, and undoubtedly in a very short time a great number of pulp

concerns and paper mills will go up in Ontario. Well, you can easily understand how difficult it will be to attempt to interfere with such a large and important industry as this, and, therefore, I hope that efforts I understand are being made in the United States will meet with success. I was very anxious to know how it stood at the present time. I understood from the Bureau of Fish and Game that this new process had been tried in experimental form to handle a portion of the waste, and had been successful.

Dr. Bean: I do not know, but I advise you to write to Mr. Burnham on that subject. He has spent a lot of time on it. I have been so busy with the protection of fish that it has been impossible for me to give any attention to that subject.

THE NECESSITY OF THE PROTECTION OF THE ADULT LOBSTER, IN ORDER TO MAINTAIN THE LOBSTER FISHERIES

BY G. W. FIELD,

Chairman Massachusetts State Fish Commission, Boston, Mass.

Mr. President and Gentlemen of the American Fisheries Society:—

The main feature to which I wish to call your attention is, the necessity of the protection of the adults, if we are to carry on the experiments and the work undertaken by Dr. Mead, and by the United States Bureau of Fisheries. It is too obvious to necessitate the calling of further attention to the fact, that if we want to raise young animals, we must have the eggs. Now the observations which we have made,—and I think they are confirmed elsewhere, both in the United States and in the British provinces,—demonstrate the fact that the decline of the lobster in point of numbers and in point of size is an actual fact; and I do not think I need to dwell upon that side of it. So that, when we come to consider the matter, we are actually face to face, not alone with a condition, but with a condition and a theory. That condition, as I have said, is the actual decline of the lobster fishery. That decline is most obvious in the neighborhood of the great markets of New York and of Boston, and possibly some points in Maine. In most sections of Maine, and in parts of Nova Scotia, that decline is marked by the fact that development of power-boats and of apparatus has gone on to such an extent that the market is apparently well supplied with lobster. But, on the other hand, greater efforts and wider territories must be covered in order to meet the market demand.

I have here some figures taken from the Massachusetts report, and I may say that those are based upon the sworn statements of the lobster fishermen, backed up somewhat by observations of persons interested in the industry. In 1890 (I select those figures because our figures before that time were more or less incomplete) in Massachusetts there were at work, 379 fishermen, and in 1906, there were at work 335 fishermen. In 1890,

there were 19,554 traps; and in 1906, 21,918 traps, an increase of more than 2,000 traps by about fifty less fishermen. The catch of lobsters in 1890 was 1,612,000; in 1906, it had fallen to 487,000. Correspondingly in 1890, the number of egg lobsters taken was 70,909; in 1906, that number had dropped to 9378 lobsters. In 1890 there was one egg lobster to every 22 captured; in 1906, there was one egg lobster to every 52 captured.

Now, it seems to me that that cannot mean anything else than a tremendous decline in the actual reproduction of the lobster. In other words, by destroying the largest lobsters, we have reduced the productive capacity of the rest to that extent, viz: in the ratio of 52 to 22.

Now, in a similar way.—and I do not care to put too much stress upon this aspect of it, although I cannot put too much on the actual decline which I have indicated, as to the ratio between the egg-bearing lobsters and the non-egg-bearing lobsters—the catch per pot in 1890 was 82, whereas in 1906, it had shrunk to 28 on the average. Now, of course, it might be said that more pots would naturally mean a decrease in the number, so that there might possibly be some misconception in regard to that: but it is an actual condition that in order to maintain the catch, you have got to put out more pots.

Now, our fishing area in Massachusetts is somewhat limited. We have not a great range of seacoast, nor the peculiarly favorable conditions that maintain in Nova Scotia. On the other hand, the fishing is peculiar in the fact that on the Massachusetts coast, we get a definite migration. They come into the harbors in July in very large numbers to shed. On the 13th day of July, there was a very marked immigration in the Boston harbor, particularly of lobsters, apparently coming in there for the purpose of shedding; they lie up there in the soft mud.

Now, the most important question, it seems to me, is, what is the cause of this decline? I have a little diagram here, unfortunately scarcely large enough to be seen all over the room—based upon our observations during the past two years, upon approximately 6,000 egg-bearing lobsters to a pot, and carefully measured—59,933 is the exact number. On this end of the line, we have the number of lobsters which were found with eggs. The smallest one we found was seven and three-quarters

inches, and below nine inches, or between eight and nine, there were but two lobsters. Between nine and ten inches, there were 117 egg-bearing lobsters; between ten and eleven inches, 1017; between eleven and twelve inches, 1749; between twelve and thirteen inches, 1902; between thirten and fourteen inches, 896; between fourteen and fifteen inches, 208; between fifteen and sixteen inches, 52; between sixteen and seventeen inches, 39.

Now, to indicate the reproductive capacity of these individuals, or rather the number of individuals represented in this, we find that the great height—the greatest number of lobsters which we find, are those between eleven and thirteen inches, or between twelve and thirteen inches is the maximum reproductive capacity. We find more lobsters bearing eggs between twelve and thirteen inches than at any other point. After that the decline, under present conditions, is rather rapid. There is, however, possibly some reason to believe that before we caught such a tremendous number of the large lobsters, this curve was somewhat different from this, and there was probably, a more steady decline, as indicated by results on certain other animals. The reproductive capacity should not drop down so rapidly.

There is no doubt that the lobster lives to a green old age. We do not know exactly how old that is, but the steam trawler, or auto-trawler is catching a very considerable number of lobsters during the past two years, which are so large that they cannot get into the present pots. The pots generally have a funnel of five or six inches, and these lobsters have a diameter of seven to eight or even more inches, and those lobsters could not get into the pot; and it is only within the past one or two years that we have found them in great numbers; they were occasionally caught on trawlers, but they are recently being caught in large numbers.

President: How much do they run in pounds?

Mr. Field: They run twenty-three pounds. Under our present laws they catch the lobsters either above eight inches in Nova Scotia, or above nine inches in New York and Rhode Island, and through other parts of Nova Scotia and at present about nine inches in Massachusetts, and above ten inches in all the other states. Now, look for a moment and see what the

result would be on the number of eggs laid if all the lobsters above ten and a half inches were to be caught, and see the further effect if all the lobsters above nine inches were to be wiped out. You would wipe out at one stroke the entire reproductive capacity of the race. Now, the only saving thing in the present lobster law, is the fact that we do not catch all the lobsters, and a certain number of these are left to reproduce. But without question it would be far better for the lobster if all those lobsters above this age were to be preserved for breeding purposes. Perhaps I ought to say in addition, that, as offsets to this destructiveness, are the first efforts to maintain and buy from fishermen, the egg-bearing lobsters. That takes care, of course, of an additional number. By using our best efforts, we have succeeded in buying, during the last two years, about 6,000 lobsters. On those, approximately 1000 or 1500 have been sent to Woods' Hole; a similar number have been sent to Gloucester; the balance has been taken out to sea five or ten miles, and liberated. We have punched holes in the tails of those 6000 lobsters, by means of an ordinary harness punch, and in that time we have bought 77, if I remember correctly, (less than 80) of those lobsters the second time, and we have bought less than five, three times. Mind you, those lobsters are taken out as green egg lobsters, or chiefly green egg lobsters, in the month of July, ten miles off shore, and there liberated; and only that relatively small number have come back and have been caught within a year, or within practically ten months.

Now another most important factor in maintaining the lobsters has been the fact that the United States' bureau of fisheries, have been far-sighted enough and have carried out with admirable success, the utilization of those eggs, which otherwise would have been destroyed by the fishermen. They have bought those eggs from the fishermen, and have hatched out many millions of eggs and delivered them in the water,—eggs which otherwise would have been destroyed by the fishermen. The eggs are certainly destroyed at the present time by fishermen in certain sections, sections so remote that they are not at the present time reached by collectors. I have in mind particularly the extreme end of Cape Cod; where a large number of fishermen go and take a whiskbroom or brush, and brush the eggs from the lob-

sters. We are absolutely certain that that is done, but at the present time, we can do nothing to stop it. We hope to do so in the immediate future.

The other efforts made, have been on the line of adopting a close season. Now, while a close season may be effective in the case of certain rapid-breeding animals, many birds, and possibly some fishes, it is very questionable whether it meets the results expected in the case of lobsters, which are remarkably slow breeders, reaching sexual maturity only after four to seven years, and after that, breeding but once in two years and carrying the eggs after they are ready, at least ten months attached to the external legs, and requiring practically another eight or ten months to prepare ovarian eggs, before they are ready; so that practically the female lobster lays but one litter of eggs every two years, although there may be individuals which lay more frequently. A close season further is subject to the criticism that it restricts the demand during a certain definite season, but does not increase the supply. It makes absolutely no difference to the future of the lobster whether those eggs are destroyed at the time they are laid, within a month after they are laid, or a month before they are hatched. So, in order to have a close season, you have got to have a close season extending over at least ten months. And ordinarily the close season is placed upon the lobster during the time when they are of use as food or during the time when they do not pot in such large numbers, because of the fact that they are migrating to the shore in order to shed. So that the ordinary close season from the first of June or the first of July to the first of September seems to me little adapted to meet conditions.

Now, we have brought forward the suggestion, based upon a biological principle, that in all our domesticated animals, we save the breeders, or at least a sufficient number of the breeders to meet the market demand for the young, and use the young for food. So the suggestion is made that we use only the lobsters, for example between nine and eleven inches, during the period when they are of least value for reproductive purposes, and at the same time of very considerable market value, and then save those above eleven inches at the very crest of their reproductive capacity, for reproductive purposes. Up to the pres-

ent time it has been very difficult to secure such a uniform law throughout all the states, for the reason, first, that the fishermen are notoriously selfish in the matter, and openly say, "As soon as the lobster is gone, we will simply turn to something else; we want all there is in the lobster business at the present time, and never mind the future." The lobster dealers have organized on the basis of using the large lobsters, and all their mechanism is adapted for present methods, and they look askance on any change. The present is all right for them, and they are not worrying about the future. With the development of transportation facilities, they are getting all the lobsters they care to sell, and they are able now, to practically handle the market as they think best.

Relative to the enforcement of such a law, it has on its face the very difficult proposition of a size limit on one side and a size limit on the other, so that opponents say, if it is difficult now to enforce the law above or below ten and one-half inches, it will be twice as hard to enforce it with a double size measure. To obviate that we have made some experiments, in which we found that a trap with a ring nine and one-quarter inches inside diameter, will shut out practically all the eleven inch lobsters, and will absolutely or practically prevent the catching of the largest lobsters, those that are most valuable for reproductive purposes; and the plan is to have those pots examined and marked and sealed, and it will be illegal to have pots in the possession of fishermen, or others different from those specified. Every pot which is made, must conform to the legal specifications, and if they do not, they can be destroyed on the spot by the inspector. That makes it much more easy to inspect the pots, that is, to inspect the lobsters; they will handle the lobster automatically.

Now, it seems to me that such a law, particularly if it is a uniform law throughout the states and provinces, would be of great value to the lobster, owing to the fact that it would permit the very best individuals to breed. At present a large portion of our eggs are taken from immature individuals. We practically put a premium upon the taking and destruction of the very best breeders, and anyone who is engaged in breeding stock, will

know how suicidal that is. It is absolutely necessary to progress to breed from the very best animals.

Further it would give every fisherman an equal chance with every other fisherman. There will be no question as to what lobsters shall be thrown overboard, or whether one man is honest and throws his lobsters overboard, to be caught by his neighbor, who is not in the habit of throwing lobsters overboard.

But, most important of all, it seems to me, it applies the biological principle of the protection of the adults to the lobster, to an animal, which, up to the present time, has never been subjected to that principle of action.

Apart from its novelty, from the fact that it practically is a reversal of the present law, certain other objections have been made to it. First, it has been said, that if you catch all the short lobsters, all the small lobsters, how will there be any large lobsters? Of course that is simply an argument in a circle. Correspondingly, if you catch all the large lobsters, there will be no small lobsters coming up. So that argument has its value only in the question as to how many of the short lobsters would be taken under these conditions.

Over against that should be placed the fact, that whereas, under the present law, we allow the catching of lobsters throughout their entire life, under this suggested law, you are restricting the catching of lobsters to practically one, or at least two molts in the lobster's life, and you know the lobster increases upwards of fifteen percent at each molt. That means that a ten inch lobster in a month would pass over into the exempt class, become practically an eleven or eleven and a half inch lobster. So that the time during which those lobsters would be subject to catch is very much diminished by a law such as is proposed.

In addition to that, there are various opinions, particularly among the fishermen, as to the size, some calling for an eight inch lower limit, and others for a twelve inch upper limit, and so on. That is a question of practical expediency, which could be settled later, but for the sake of argument, we have settled upon this matter of nine to eleven as the best size to be recommended.

That, in general, is an outline of what we have had in mind. I am very glad indeed to talk the matter over further, or answer

any questions I might. I have covered the subject, I realize, very unsatisfactorily. We have discussed it at greater length in a pamphlet, which I would be glad to furnish to anyone who cares for it.

I thank you. (Great applause.)

DISCUSSION.

Professor Mead: I would like to ask Dr. Field one question about the curve. The curve, as I understand, is made up of the number of the egg lobsters.

Mr. Field: Yes.

Professor Mead: Does it show what the proportion of egg lobsters, to all lobsters is, at any particular period of life?

Mr. Field: No, it is made in this way: For example, we found 1749 lobsters of a size between 11 and 12 inches.

Professor Mead: How many lobsters are there in all in that period?

Mr. Field: These are all egg lobsters, every one.

Professor Mead: How many lobsters are there of that same length that are not egg lobsters? Does the curve in your diagram show the proportion of egg lobsters to all the lobsters?

Mr. Field: No, not at all. The only figures we have on that are those which I quoted, in which we found that at the present time, there was one egg lobster to every 52 in the Massachusetts catch; but we know nothing about the relative size of the other individuals. We do know that there is one egg lobster to every 52, above 10½ inches, that is as near as we can get to it from the figures in our possession.

Professor Mead: I had supposed that curve indicated why you picked out that particular period—because of the greater fecundity of lobsters.

Mr. Field: No.

Professor Mead: Why wouldn't it be a good plan if you are going to take a curve and pick out the 10½ to 11 inch period, to take out those big lobsters, which do not lay any eggs.

Mr. Field: Yes, they do lay more eggs. This is the number, but this does not represent the value of the eggs. These larger lobsters, of 15 and 16 inches will lay in the neighborhood of 60,000 to 80,000 eggs, whereas these down here (indicating) would lay only about 5,000 to 10,000, these practically on this side of the line not over 20,000, whereas these on this side lay from 20,000 to 80,000 or 90,000 eggs.

Professor Mead: On the other hand, those lobsters, if they are allowed to live, as indicated, on the first side of the line of your diagram, will produce for several seasons, while those on the other side are rapidly declining.

Mr. Field: It is a question whether they are rapidly declining.

Professor Mead: Although they are worth two or three times as much for food.

Mr. Field: We found in our observations that there are about six times as many lobsters between 9 and 11 inches as there are those above that,—at least that,—we don't know but more in certain places. Let a man go out in a boat, and measure every lobster that came into the pot in order to get an idea of the number of lobsters of that particular capacity.

President: Your idea would be to exempt those between 11 and 14 inches.

Professor Mead: I have not made that as a definite proposition, but I do not see why according to the curve he has got there, you should not exempt the larger ones.

Mr. Field: The thing you have in mind is represented by one curve, and this represents another thing. This curve does not show the capacity.

Professor Mead: That would not represent the truth, because your absolute capacity depends both upon the number and the number of eggs per individual.

Mr. Field: That is true.

Professor Mead: But it does seem to me, if you kill off the

comparatively young lobsters, you are throwing great stress upon very valuable breeders. If you take out the 9 to 11 inch lobsters, you are taking out those which can breed now, and those which would breed again and again if you left them alone, and of course, you are throwing additional stress upon that limited period, by exempting the other lobsters, among which are the very large lobsters which are rapidly declined in their breeding capacity.

Mr. Field: It is a question whether they are rapidly declining. There was no question according to various observations that they increase up to 17 inches, and after that, we do not know anything about them. At 16 inches you have 19,000 eggs.

Professor Mead: You had only 19,000, that was less.

Mr. Field: We do not know how rapidly the decline is. The chances are the decline is about the same as the increasing curve.

President: Any further discussion of the paper?

Mr. Field: I ought to say, that perhaps Dr. Mead overlooks the fact or assumes that a tremendous number would be destroyed, and that is doubtless true; at the same time there would be a large number which would get by, for the reason there is a relatively short period in their lives where they are exposed to capture, whereas, at the present time, they are exposed to capture throughout their entire life.

Professor Mead: I am interested in this subject, and have talked with Dr. Field a great many times, and we have always failed to agree as to the effect of protecting the young or old, just as some people present have failed to agree on the general principle of "Fry vs. Fingerlings." Just now he brought up the objection to his theory, which presents itself to everyone, that by allowing the old lobsters to be exempt, great stress is brought upon the young. He said, in explanation of his curve, that it would be a terrible thing if all of the old egg-bearing lobsters were wiped out. Of course, it is equally true that if all the young ones were wiped out, it would be unfortunate. It seems to me there is one thing that ought not to be overlooked,

that is, throwing the stress on the young lobsters with which the fishermen must fill the market demand. This will take a good many more lobsters than if they are allowed to capture the old ones. I know perfectly well this argument is a plausible one; but it seems to me the case here is a little different from that of domesticated animals, like chickens, where within a year or two, the weight of the young is quite as great as that of the old. But take the 9 inch lobster, and you have got to sacrifice a good many to make up for one old lobster, and moreover, the old lobsters, when they have reached a certain size, are good for nothing. The proposition as modified by Dr. Field, of allowing simply the lobsters between 9 and 11 inches to be caught is quite a different proposition from allowing those below 9 inches to be caught. I admit that I have wondered, however, how this would work out practically among the fishermen, in whom human nature is strong,—our Greek and Portugnese and other fishermen along the Atlantic Coast. They are very unwilling now to allow the egg lobsters to get by, or to allow the young lobsters to get by. It seems to me there would be much difficulty in persuading them that they ought to allow the old lobsters to go by. It takes a good deal of nerve to throw over a good three or four pound lobster on general principles. That, of course, is a practical point. I have often wondered too whether the general principle would be admitted, of taking the young and leaving the old, by the practical fish culturist; whether if he had a lake full of trout, he would be willing to pick out each year all of the young trout and leave the old ones.

I think it is very important, and of course a good many have also put out the same opinion, that we should have along the Atlantic Coast from Maine to New York uniform laws. Dr. Field himself has taken steps towards bringing about such a result.

I think that is important, for it has been shown that the difference in the law for example, between Massachusetts and Rhode Island, was very detrimental to Massachusetts. When the people right on the line between Rhode Island and Massachusetts can take 9 to 10½ inch lobsters and bring them over into Newport and sell them, it is very natural that they should do it. You cannot catch them, because they put the shorts in

the well, and kick the bottom out, if they see the police coming. Newport has been loaded up with lobsters from Massachusetts. We thought some time ago of increasing the limit in Rhode Island to a little larger than it is in Connecticut. But it seemed to me the same trouble would occur there, and Rhode Island fishermen would take their lobsters over into Connecticut.

With respect to the biological aspect of the question at issue I have taken the view that what we need is protection for the very small lobsters and not merely or perhaps not mainly an increase in the number of eggs. Of course every one knows that if the lobster on the average produces 10,000 eggs, 9,999 of them do not reach maturity on the average, otherwise the sea would be filled with lobsters in a very short time. There is an overproduction among animals as a rule, and it is counteracted by corresponding destruction of the immature. There are therefore two opposite ways by which a species in nature maintain their abundance; one by producing enormous numbers of young without much provision for protection, as is the case with the shad, lobster and scallop, the other by producing small numbers of young and providing special protection for them, as in case of the dogfish, skate, toad-fish and the abundant species *Crepidula* among mollusks.

In dealing with a species like the lobster where the number of young and the infant mortality are great, it looks to me as though we can do more good by following the first named method, that of protecting the young, than by endeavoring to produce greater quantities of young to be a sacrifice. Now, there is no question at all, I think, that the usual destruction of lobster fry, immediately after the eggs are hatched, is perfectly enormous, and then is lessened step by step as the lobster grows older. There is no doubt that fingerling lobsters too, are destroyed in considerable numbers, by cat and dogfish. But as they increase in size the destruction is proportionately less. Of course, that might be applied in different ways, but to my mind it shows that the lobsters that have gone through a period up to when they can begin to breed are very valuable lobsters, and they ought not then to be killed off before they have a chance to breed. I know that the original proposition of Dr. Field's appeals strongly to a great many people at first glance; it is a very plausible

theory, and so much like the old academic question of the hen and the egg—which comes from which, that it is very puzzling. One thinks one way one day and another way another. The practical side must have a very strong influence in deciding what the legislature shall do about it. I think it can hardly be treated entirely as an academic problem, partly because, although Dr. Field has very many interesting statistics—we have not sufficient information in regard to the proportion of the large egg lobsters to all of the egg lobsters, and many other questions of that kind.

Dr. Field: I would say, Mr. President, that one important question which we have in our department is the enforcement of the law, and there is no law more difficult to enforce than the present lobster law, whether it be 9 inches or 10½ inches, so that the suggestion made that the law be transferred to the pot instead of the lobster, is going to be a great step in advance in dealing with the Greek and Portuguese fishermen, of whom Dr. Mead speaks and with whom I am very familiar. It is perfectly feasible to examine the pots, and to pull up the pots and measure them, and see that they have been inspected, where it is absolutely impossible to chase a man, and get the short lobsters in his possession.

Now, in regard to the practical aspect of this, and the effect upon the market of a change in the law, we have been in the market and measured some of the local lobsters and Nova Scotia lobsters exactly as they are found in the Boston market today, and we have compared those with the number that we have to use in order to get exactly the same weight of lobsters if they allowed the taking only of those between nine and ten inches, and we find they have to handle 155 to every 100 at the present time. That would practically be an increase of 55 lobsters in every 100 instead of the killing of a large number of lobsters as Dr. Mead has suggested might be possible.

We ought to say, of course, that we are pleased with the work of Dr. Mead and of the Rhode Island commission and of the United States bureau of fisheries, and very sorry indeed to see them placed in the position of the man who did not take his medicine, so that he was never able to tell what it was that cured him. In short, while we believe that the short lobsters ought to

be protected until they reach the market size of approximately 9 inches, we believe that the market ought to be allowed to have certain lobsters, which would be placed upon the market with the least harm, and that, it seems to us, is between 9 and 11 inches, before they have reached the highest period of maturity, and when they have reached a size where they are of considerable commercial importance.

President: Speaking from the standpoint of a state whose lobsters are all of the crawfish variety, I do not believe that this proposition can be solved except by trying it; that the arguments both ways are pretty good and that Massachusetts better try and see whether the lobsters will increase on it.

THE INFLUENCE OF POLITICS UPON THE WORK OF THE FISH CULTURIST, AND HOW FISH AND GAME PROTECTIVE ASSOCIATIONS MAY ASSIST THE LATTER

And

THE INTERNATIONAL PROBLEM OF THE PROPER REGULATION OF THE FISHERIES OF THE GREAT LAKES

BY A. KELLY EVANS, OF TORONTO, CANADA.

Mr. A. Kelly Evans: Mr. President and gentlemen, it is with a great deal of trepidation indeed that I venture to make a few remarks, considering that the gentlemen may be considered savants on the question of fish culture, but as I shall not be long, I trust you will bear with me. I want to give you an idea of what might be deemed the necessity of taking an interest in organizations which may help you largely in the work you are carrying out. I refer to fish and game protective associations and organizations of that kind; and in order to make my argument clearer, I wish to explain certain things that have occurred in our province of Ontario.

I feel you must all take an interest in the province of Ontario, particularly because it controls practically one half of the fisheries of the Great Lakes. Besides this, it has enormous resources in other lakes which do not touch your borders, besides very large rivers. There have been two commissions appointed of late years in Canada, one by the provincial government at Toronto, a liberal administration, and one by a conservative administration at Ottawa. This document is a very rare one. It contains such an expose of the horrible destruction that has been going on, that it has been more or less suppressed; but I am fortunate enough to possess a copy, and I will simply read one little bit of sworn testimony to show you the condition existing in Lake Ontario comparatively a small number of years ago; you are quite aware of the condition existing now.

This commission was appointed by the late Sir Hibbard Tupper, in 1893. The commissioners proceeded all through the

country, and the evidence was taken in large quantities, under oath, in a most exhaustive way. The evidence of this man which I am going to quote, I chose partly because he was an American citizen, afterwards becoming naturalized in our country. This evidence was under oath.

Mr. Robert Hutchins, was duly sworn. Lives in Midland. Has been a fisherman since 1850. Is a British subject since then, though born in the United States. Has fished here and in Georgian Bay for fourteen years. Balance of the time in Lake Ontario.

"I have fished in Lake Ontario about thirty years for whitefish and trout, the great majority was whitefish, and caught at Wellington Beach: they were caught very numerously with seines; as many as from five thousand to ten thousand in one haul during a night; this was in the summer time, in June and July, and these were salted or sold on the ground, to dealers. I have caught as many in a season as would allow the owners of the seine for their share about $2,000.00, the other $2,000.00 would go to the fishermen; even more than this number were caught sometimes. Fishing was carried on in the fall of the year also. Whitefish were thick also everywhere in Lake Ontario at that time. I have known as many as 90,000 to be taken in one haul in one night; I was present and saw them counted. I have often known of from 5,000 to 10,000 being taken, and have taken 40,000 myself in a seine several times. This was in July, at Wellington Beach. Those that were saved of the 90,000 haul were salted; many of these were lost because they could not be taken care of. There was another haul as large as this taken at West Lake Beach; the net was a one hundred and seventy-five rod seine and it was then called, 'the sou-wester'. When I left Lake Ontario some fourteen years ago, there were no whitefish to be had by the fishermen where these great hauls had been made before, in fact the whitefish fishery had ceased to exist, there was no more of it. I left Lake Ontario to fish here, and a number of other fishermen also left there for the same cause."

You know of the horrible destruction that took place about the time that he is speaking of, here in the Detroit River, where on the Canadian side we had pens constructed and where immense destruction was caused to the fish.

Now it is unnecessary to tell you that in this report, the recommendations of the commissioner were very sweeping. This report of the Ontario government was obtained something in the same way, except, that in reference to the fisheries, they sent out written questions which were answered by 497 persons of all descriptions, and besides that they took sworn testimony at many points throughout the province. The only points that I will draw to your attention are some of the recommendations of these commissioners.

"Your commissioners are of the opinion that pound nets should be entirely abolished in the waters of the province. The extent to which netting is carried on is also inconceivable, and the spawning grounds are stripped year after year until in many places where fish abounded formerly in large numbers, there is no yield now at all. If a force of game wardens was appointed, this matter could be vigorously looked into and the slaughter and destruction could be very considerably lessened. The value of the fish yield is enormous, and too much pains can not be taken to preserve what should be always a cheap food supply for the masses."

And so on, through their report, it is a damning arraignment of the existing condition of things.

Now, gentlemen, it is inconceivable to believe that any statesman wishes to do harm to his country, and when I tell you that those two documents, prepared at great expenditure of time and money of the people, undertaken by scientists and men who are quite qualified in taking evidence and making the examination and recommendations, are practically a dead letter, the query "why?" must come in.

Each one of the constituencies on lake Ontario and lake Erie has a small fringe or border upon the lake, and the members of parliament, at each election, the candidates for reelection seeking the suffrages of the people, have from time to time gone and made promises to the net fishermen; first, a diminution in the size of the meshes of the nets; secondly, an extension into the breeding seasons of the time in which nets could be placed; and thirdly, an increase of net licenses beyond the possibility of the water to take care of. But those same gentlemen never went into the territory of their several constituencies and told the

people there that they were making promises which must in the end take from their mouths a valuable food supply. In other words, to obtain the votes of a handful of the community, this large and important industry has practically been destroyed.

Now here is where the assistance of such organizations as I advise you to take an interest in, comes in. Most of you gentlemen, I take it, hold positions, either at the bureau of fisheries at Washington, or in other states, which largely debar you from taking any active part in politics. You will place, just as these gentlemen have done, in the reports of wastes, recommendations before your legislatures; but unless you have some force outside of yourself to back up those resolutions, I fear that most of them will meet the fate that those two have met.

Now the association which I have been instrumental in forming, the Ontario Fish and Game Protective Association, is one which I would like to call to your attention, and I have with me a number of copies of the constitution and by-laws which I shall be glad to distribute.

This organization was started in 1905, with headquarters at Toronto and branches throughout the province. It has been necessary to find people who would take an active interest and make sacrifices. It so happens that Mr. Oliver Adams and myself have been able to do that, and by making public addresses, we have succeeded in forming thirty-five branches in the last two years. The result was that we were able at the last session, to have a bill passed which undoubtedly changes the whole condition of things. I am perfectly convinced that without that association having been formed, without it having worked in an energetic manner, we never could have had the present game act passed.

I should like, in concluding that portion of my remarks, to point out a method by which blue books are often used, either intentionally or unintentionally, to mislead people. There has undoubtedly been an immense falling off in the fisheries of the Great Lakes, that is, a falling off in the weight or pounds in the catch of our waters, while the money value remains almost the same, in the value of the fish; and if you examine that report of the department of fisheries in the department of Ontario for 1906 in a casual way, your attention is not called to the falling

off in pounds, but to the fact that the values have not decreased. For instance, we find that in 1906 the total catch for this year is 23,000,000 odd pounds, and we are given a value of $1,735,000; if we turn to the year 1890, we find that the value of the fisheries for that year is over $2,000,000; the weight, however, is 29,000,000 pounds as against 23,000,000 pounds. In other words, there is a total decrease of in the neighborhood of 6,000,000 pounds, and if you average the present selling price at eight cents (for, mark you, the difference in weight is mainly in the more valuable forms of fish, such as the whitefish and trout) you would note an annual decrease of in the neighborhood of $480,000. That, of course, can be varied by the average price of the fish: I am putting it at eight cents; running it down to six cents, it would be $360,000. If you capitalize either of those sums at five percent, you will find that the capital assets of the Province of Ontario have decreased anywhere from $6,000,000 to $8,000,000. Now, here again, is where the association which I represent is able to do good work. We are able to bring these facts to the attention of the people; to dissect the blue books, and to expose what I take it are either intentionally or unintentionally, misleading statements on the part of the authorities.

Again we are able, as we have done on several occasions, by the formation of these branches, to produce definite voting strength, without delving actually into politics, where we have a large branch such as Hastings County branch. We were able, for the first time in fifty years, to make the fishermen of the Bay Canadian, one of the most important fishing grounds for Lake Ontario whitefish on the lakes, realize for the first time that there was a force outside of themselves in their waters which must and should be harkened to by the government. The fish culturist and the scientist had for years pointed out that the Bay was a natural spawning ground. We made recommendations which had not been adopted; but when the authorities realized, and when the members themselves understood, that here was a force that they must count upon, men of importance in the community, representative citizens, men who must be listened to, when they felt that there was that cohesive strength, which would be developed at the next election, and we were able to make the fishermen realize that the fish swimming in the

waters belonged to the mechanics of the city of Toronto as much as to the men living on the water front, we could accomplish something.

And it is on those grounds that I ask you, as far as it is in you power, to encourage bodies of men who may not have the same scientific attainment and knowledge as yourselves, but who may be able to help you in the work you are carrying on.

Now I should like to make a few remarks in relation to the international aspect of this case. I have heard since I have been here a great many remarks about the necessity of handing the government of the fisheries of the several states over to the federal authorities, and I quite realize that this is a necessity if you are to have uniform regulations looking to seasons, sizes of meshes and general matters. But with us on our side we have a peculiar anomaly. There is a divided authority. The fisheries of the Great Lakes on our side are regulated by the Dominion Government, while we in Ontario alone have the power of issuing net licenses. In other words, we may stop the fishing, but we cannot change the regulations. There are political reasons in the Dominion of Canada, which it would take me too long to explain, which I think take it out of the realm of practical politics to expect the province of Ontario to give up any little remnant of authority it has over the fisheries of the Great Lakes; and the consequence is that anything done at the present time in reference to some better understanding between the states and Canada must come first before the people representing the province of Ontario, not those representing the Dominion power; and in consequence I would suggest to this society that if they could first of all get their states together, to hand over to the federal government the powers in reference to the regulation of the fisheries of the Great Lakes, we in Ontario might have a better chance of getting the people to the point that they would be willing to hand over to the Dominion Government their rights as to licenses and place the whole thing in the hands of the two powers. But to start with, I think that there would be much greater possibility of success if an informal conference should be arranged between representatives of the sovereign states bordering on the Great Lakes, representatives of the province of Ontario, and representatives of the Dominion Gov-

ernment. If an informal conference of that kind should be called, it would at any rate clear the air, and it might be possible after that to have a conference commission of a more formal nature.

To show you that something should be done, and something should be done soon, I may tell you and frankly warn you that it is quite probable that within a very few years there may be passed a bill prohibiting the export of food fish from our provincial waters. Now, considering that 85 percent of our total catch comes to this country, you can realize the importance to yourselves of this question. You must remember, and you cannot fail to understand, that when citizens of Toronto have been known to buy Ontario-caught fish from Buffalo dealers, paying their own duty, the American duty, and the added freight, that such a thing, if brought to the attention of the public, will undoubtedly cause trouble. This has occurred and occurred often. The proprietor of the Clifton Hotel has placed in writing the complaint that he has to buy from Buffalo, Ontario-caught fish, and that he cannot get them from his own dealers; and his own dealers state that they have made application for fish, and that they find they are contracted for to the States. Now, there is an understanding, when licenses are issued by the provincial government, that the fishermen must supply the local market first. This has been very much ignored. As a matter of fact, there are fishermen in this town, who know that I state absolutely the fact, when I say that the ice houses, the tugs, the whole machinery of carrying on the fishing industry of Lake Superior and Lake Huron is entirely in the hands of what might be concisely termed, "the American fish trust." Now, gentlemen, there is a feeling in our country that we are being turned into hewers of wood and drawers of water; that we are getting a very small sum for this 85 percent of the fish that is coming over here; and when that feeling is added to by other little frictions that may come up from time to time, you will see that there is a possibility of the prohibition of the export of food fish. If within the next two or three years, you are able to take up such an informal conference, as I suggest, and if that conference is able to come to definite conclusions on two or three important basic points; for instance, that no fish that has not

reached a size capable of reproducing its species can be caught, and that nets and machinery for catching fish are regulated upon that principle, also that in the markets no fish beneath such regulated size would be allowed by law to be sold; if all that is done, I firmly believe that it will withdraw a good many of the reasons which are tending in the direction of a possible prohibition of the export of the food fish. And therefore, on those grounds alone, I ask your earnest cooperation. I ask your efforts especially in the direction of getting up such an international conference. There are political reasons why such a suggestion can hardly proceed from the province of Ontario; but if such a suggestion should be received from the great sovereign States, bordering upon the Great Lakes, I believe that it would be heartily met by the authorities both at Ottawa and Ontario.

In speaking in this way, recollect, gentlemen, that I am simply the working head of this association, because I think so many of you are connected with bureaus of different kinds, that you might possibly imagine I was connected with some bureau in my own country. I have no connection whatever with the government, nor do I receive, nor does my association receive, any support from the government. In fact, in many ways we are making it a little bit embarrassing and unpleasant for the government, in the direction of trying to make them carry out the laws they have put on their statute books.

In closing, I will simply quote from the report of Mr. Tinsley on pages eight and nine of the 1906 issue of the report of the department of fisheries of the province of Ontario, to show you that the remarks which I have made, as it were as an independent person, an absolute free lance, having no strings upon me, are borne out by an official occupying the position of a deputy head of the department of fisheries of the province of Ontario.

He says:

"The Great Lakes Fisheries."

"During the past year little has been done in the matter of harmonizing the fishery laws and regulations applicable to international waters. Although this important matter has to some extent been in abeyance during 1906, it has not been lost sight

of, and will no doubt receive the consideration it is entitled to in the near future."

Referring to this matter in the report for 1905, the then deputy commissioner of fisheries did so as follows: "The circular letter which in 1904 was addressed to every licensed fisherman in the province notifying him that he must make arrangements for supplying the local demand for fish does not appear to have received that attention which was hoped and expected. This is a question of dollars and cents, and not of patriotism or sentiment. It rests with the public and not with the fishermen to establish a home market, which can only be accomplished in two ways, namely, by the Dominion Government prohibiting export, or residents of the province being prepared to pay the price for Ontario fish they realize in the United States."

You see, gentlemen, there are just two ways, and if the people say, we will have our own fish, they will choose the former way.

"The public fail to recognize the changed conditions from those prevailing fifteen years ago. At that time the fresh water fisheries of the United States had not been depleted, neither was the fishing business of Ontario controlled by powerful American combines. Not many years back, fishermen on the shores of Lake Erie were satisfied to sell herring at one cent per pound, whitefish and salmon trout at five cents a pound—the price now realized in many markets for the much abused carp. However desirable it may be to have our home markets abundantly supplied with good wholesome fish, this will not occur under present conditions, but our fish will reach those markets paying the most for them.

As to the ownership of the gear, tugs, boats, nets, etc., etc., operated by the fishermen. Such enquiry is not required, if, as stated in report for 1905, this department found, upon assuming the administration of the fisheries in 1898, that the fishing industry of the Great Lakes was largely controlled by American companies. If American ownership and control prevailed in 1898, we may rest assured that such control prevails now to a far greater extent than in 1898. We have the most convincing proof of American control when we revert to the well known fact that at least three-fourths of the fish caught in the Great Lakes

by the licensed fishermen of the province reach the United States direct from the nets, thus evading with impunity espionage or inspection by provincial officials."

Now you see, gentlemen, there is where you put your finger on what is a sore spot to us. If we had an international agreement as to the size of the fish, we would know that the fish was legally caught and legally shipped; but when we know as a positive fact that large quantities of fish way under our legal size are going into your markets, it rises in the gorge of our people. And that is another reason why again I plead with you to try and bring about some interprovincial and interstate informal conference and try and arrange these matters so that we can get along much better together.

"To devise means for effective inspection is urgently required, and not further proof of ownership and control by American fish companies, a fact already so well established. The fish of our lakes, rivers and streams are a grand heritage left us by nature to be used wisely for the benefit of all, and not for the purpose of being exterminated to satisfy the greed and rapacity of a few powerful and dominating alien fish companies."

Now, gentlemen, that is language stronger than I have used, and that is language from the deputy head of the department of fisheries of the province of Ontario.

With those facts in view, and with the knowledge that you have in reference to the fisheries of these Great Lakes, in which you are undoubtedly as much interested as we, and in which we have as great a share as you, I do trust and hope, gentlemen, that you will in a sense forget during your labors sometimes the more scientific and interesting portions of the work of the society, and remember the practical application of the theories and experiments you are so nobly carrying out.

One thing which I have learned since I arrived here has given me a great deal of pleasure, and that is the tremendously good work being done by your several commissions. I find from Mr. Meehan that some 600,000,000 of fry have been put in the waters mainly in the lakes alone, from his hatcheries, and I do think that even if you are getting 85 per cent of our fish, you are certainly putting in ten times as much fry as we are; there is no question or doubt about that. I have to apologize in a sense

for our want of work in the direction of hatcheries; but I do believe, (to show you the importance of the interprovincial informal conference I have suggested,) that if you all got together in that way, when the officials appointed by the dominion and the provincial governments meet you and see the great work you are doing in restocking hatcheries, that they would be shamed into placing more money in the estimates for these purposes, and that we should have, as we ought to have, just as fine hatcheries as Mr. Meehan so splendidly carries on here in Pennsylvania.

Gentlemen, I thank you for the kind way in which you have listened to me. If I have made any remarks that may at all offend you, I am indeed sorry; but I am working, as I believe, for the best interests of the province in which I was born, a province, gentlemen, that is larger I think than any of your states with the exception of Texas, a province that has immense possibilities, and a province which will shortly build a railroad to Hudson Bay and make it possible to transship to your markets some of the finest salt water fish in the world. And again, I work because I want, by the time that railroad touches Hudson Bay to have public opinion so wrought up over the proper regulation of the fisheries we possess, that it will not allow that magnificent body of water to be depleted as most of our other lakes have been. (Great applause.)

MANIPULATION OF SALMON EGGS

BY CHARLES G. ATKINS, EAST ORLAND, MAINE.

It is my purpose in this paper to state only the methods in vogue at the stations in Maine that have been under my personal direction, of which the primary one is at Craig Brook in the town of Orland and county of Hancock. The kinds handled have been the sea-going Atlantic salmon, *Salmo salar* and its landlocked variety, *Salmo salar sebago*. Several species of trout have been propagated and their eggs have been handled in substantially the same way. It will therefore place the methods fully before you, if I confine myself to the work on the sea-going Atlantic salmon. There has been some change in the apparatus since the inception of this work in 1871, but for now some twenty years apparatus and methods have been practically unchanged.

The eggs of Atlantic salmon are all taken from adult fish collected by purchase from the commercial fishermen in and about the mouth of the Penobscot river during the months of May and June each year. All these fish are fresh from the ocean and are in prime condition, smooth, bright and fat. It being impracticable to distinguish the sexes at that season of the year, no attention is paid to that matter in collections, nor is any distinction made as to size. But it always turns out that the majority of the salmon collected are females and while the size ranges from eight to thirty pounds weight (rarely outside of these dimensions above or below) the mean weight is somewhere between 11½ and 13½ pounds. The salmon collected are conveyed in floating cars from the places of capture to an enclosure in a fresh-water stream, where they pass the summer and autumn, until the spawning season, which begins between October 20 and 25. They are then brought into narrow quarters, dipped up and examined, one by one, and as fast as they are found ripe the spawn is taken.

The spawning party works under a shed snug by the bank of the enclosure. The spawn-taker sits on a box with a common tin milk-pan before him. Seizing a female fish by the tail with his right hand he holds her up for a moment to judge by the

appearance of the abdomen whether her eggs are ripe, and then, if she is ready, swinging her head under his left arm so as to allow the left hand to be used in pressing the abdomen, he holds her over the pan and, as soon as her first struggling is over, presses out the spawn in a leisurely way taking, however, rarely more than ten minutes in the operation. As soon as the female has yielded her eggs a male is taken in the same way and his milt expressed upon the eggs. The eggs and milt are then thoroughly mixed together by shaking and whirling the pan about. Then for the first time water is added by a second operator, who repeats the mixing motions and very shortly washes the milt all off, fills up with clean water and sets the pan of eggs on a shelf to swell. This process being completed, the eggs are, as soon as convenient, generally after the lapse of several hours, spread upon the wire-cloth trays on which they are to be incubated, enclosed in light-tight boxes and transferred to the hatchery, which transfer involves carrying over rough ground by foot-porters and by boat across a lake, a total distance of nearly two miles.

Arrived at the hatchery, the eggs are removed from the box and, on the same trays on which they are brought, are placed in movable frames in wooden troughs fed by water from a brook whose source is a small lake of exceptional purity located at a much greater elevation, from which the water comes tumbling down over rocks and ledges and arrives at the hatchery well aerated. The temperature of this water during the past year ranged from 50° F. at the end of October and a mean of 42.5° F. in November to a mean of 33.2° F. in February; being a little more than one degree warmer through March and attaining a mean of 36.6° F. in April and 45.5° F. in May. The progress of development is of course very slow in such cool water, and the period of incubation is about five months.

The water in the troughs has altogether a horizontal flow. The trays are constructed in such a way that while resting on each other at the corners there are narrow interstices between them reaching across each side, which are sufficient to admit water in ample volume to nourish the eggs, but not deep enough to allow salmon eggs to be washed out should the flow be excessive. In this system no use whatever is made of vertical cur-

rents of water, either up or down, and the dispensing with them has several advantages, among which may be mentioned the saving of expense in construction, and such a simplification of the trough that as soon as the frames carrying eggs are lifted out it is ready for fish. These frames, locally termed "stack-frames," are made of square wooden bases with vertical corner pieces of sheet metal which reach up to the surface and hold all of the trays in place by clasping them at the corners. These stack-frames, with their contents, are lifted at pleasure by means of hooks which are held in the hands and inserted in perforations in the corner-pieces, and any stack can be taken out without in any degree interfering with the neighboring stacks. There are in use two depths of troughs: the 9 in. trough, a stack for which carries 20,000 salmon eggs, or 140,000 or more in a trough 10 ft. long; and a 17 inch trough which carries twice as many in the same length.

When the eggs are picked, which is generally once a week, (the low temperature not requiring it oftener) the stacks are one by one lifted from the trough and carried in a shallow but tight box to the picking table where the light is ample and the operator can stand erect in a position most favorable to both personal comfort and effective work. The trays are now inspected, one by one, the dead eggs removed, and the tray transferred to another stack-frame which stands alongside, having been rinsed in clean water meanwhile if that appears desirable. When all the trays have thus been picked and placed in the new frame, the latter with its contents is returned to the trough. The whole operation is simple and quickly performed. The exposure of the eggs to the air while out of the trough does not do the slightest harm if the room is cool—we aim to keep it below 55° F. With only ordinary care it is easy to handle the eggs so gently that not the slightest harm is done to them even at the most delicate stage, and picking is never intermitted on account of stage of development.

I have been thus minute in describing these operations with the hope of thereby drawing a vivid picture of a system which appears to me to meet all the requirements better than any other of which I have heard. I may add that I know of no other system that appears to be so well adapted to the meeting of

emergencies. Should it be inconvenient to transfer the eggs from the place of capture to the hatchery at once, the whole stack can be set into a brook and rest there over night or even longer. In case of a sudden failure of water in the hatchery, or of the building taking fire, it is but the work of a very short time to remove the eggs to a place of safety. If, in such an emergency, another place in water cannot be immediately provided, the stacks of eggs can be placed in a cellar or other place where extremes of temperature can be avoided and there wait safely for several days the preparation of a place for their reception. No system known to me is so independent of a fall of water at the hatchery. It is possible to safely carry eggs through the whole period of incubation up to the point of hatching, with half an inch fall in 10 feet. Should there be no available site for developing-troughs on the land, it would be quite possible to use a floating trough, with an opening at each end for ingress and egress of water, of any size demanded by the strength of the current. This might be a very useful arrangement at some collecting stations: the eggs could remain as many days as convenient in the floating trough and then taken out and transferred on the same trays and in the same stack-frames to even a very distant hatchery; and by taking the precaution to pack the space between each layer of eggs and the tray above it with soft material—say moss between pieces of cloth—this transfer can be made successfully at the most delicate stage of development. This was actually done with a lot of salmon eggs transferred in November, 1904, from Craig Brook to the auxiliary station at Little Spring Brook on the upper Penobscot river, a distance of 114 miles, of which 120 miles was by rail, 7 miles by wagon on a rough road and 17 miles on a sled. The eggs were packed Nov. 14, started Nov. 15, and reached their destination Nov. 16; and the loss en route was less than one per cent. Among other eggs in the same package, all at the stages when handling is usually avoided, there was one lot of 2,200 eggs, 13 days from impregnation, (in water of 46½° F. Nov. 1 and 42° F. Nov. 14), in which the embryo had spread to cover one-third of the surface of the yolk,—a very delicate stage. In this lot but three dead eggs could be found on unpacking and 14 the next day.

The water supply to the hatchery is only roughly filtered and

there is considerable deposit of sediment on the eggs. It is customary to wash this off at the time of picking by dipping the tray of eggs in a pan of water, but close observation has shown that this may safely be omitted. Eggs have been allowed to go unwashed until the sediment was so thick on them that it was no longer possible to distinguish between a normal egg and a white one, yet not the slightest harm followed. Undoubtedly the embryos are sufficiently nourished by the current of water flowing underneath the tray and having free access through the coarse meshes of the wire-cloth to the clean underside of the eggs.

The question of the exhaustion of the life-giving properties of the water by ministering to so many eggs was also looked into, and it was found that the eggs at the foot of the trough, which received only water that had already passed through 6 or 7 stacks of eggs were equally well nourished with those at its head.

The elimination of the unimpregnated eggs is effected by concussion. When the eggs have reached the stage at which they are usually transported, or a little earlier, they are turned from the trays into tin pans with water and then poured back and forth a dozen times, the eggs striking hard against the bottom of the pan, so as to give each egg a severe shock. After this the eggs are returned to the troughs and left until next day, when it is found that all the unimpregnated eggs have turned white, but that the impregnated are not injured. This operation is always attended to before eggs are packed for shipment, with the result that the loss en route is exceeding small.

The quality of the eggs resulting from the manipulation described, and that of the fry subsequently hatched have always been the best possible, indicating the efficiency of the methods.

THE RESPIRATION OF AN INLAND LAKE

BY EDWARD A. BIRGE,

Secretary of the Commissioners of Fisheries, Wisconsin

An inland lake has often been compared to a living being, and this has always seemed to me one of the happiest of the attempts to find resemblances between animate and inanimate objects. Unlike many such comparisons, which turn on a single point of resemblance and whose fitness disappears as soon as the objects are viewed from a different position, the appropriateness of this increases rather than diminishes as our knowledge both of lakes and of living beings is enlarged.

The lake, like the organism, has its birth and its periods of growth, maturity, old age, and death; and this fact is an obvious one, for of all the larger features of the landscape, the lake is the youngest and the most temporary. Its birth lies in the recent past and in no very long space of time its existence must come to an end. In any lake district, lakes may be found in all stages of maturity and decay, and many dead lakes will be seen, —places where lakes once existed which are now extinct. Lakes show not only the cycle of individual existence, but also the rhythm of seasonal activity. The activity of the lake in summer, both physical and vital, contrasts sharply with its torpidity in winter. And the lake resembles the organism not only in its annual recurrence of activity. The comparison may be pushed further and extended to the minor fluctuations of the vigor of vital manifestations which characterize lake and organism alike.

In all these points, and in many others, the lake resembles a living being; but in no respect does it resemble an organism more closely than in the topic on which I am going to speak to you, namely, its respiration. In this comparison, the resemblance is rather in processes and operations than in form. The lake is morphologically a very simple creature, resembling rather a gigantic amoeba than a more highly organized being. Perhaps it would be better to compare the lake, for the purpose of this subject, not with the organism as a whole, but with the special respiratory substance of the animal—the blood.

Like the blood of the higher animals, the lake consists of

an unorganized fluid—the plasma of the blood and the water of the lake—and of numerous organized and actively living parts—cells in the case of blood, and the plants and animals in the lake. As is the case in the animal, the respiratory gases are absorbed and transmitted to the living structures by means of the unorganized fluid. It is my purpose to trace in outline the history of these processes and their result upon the activity of the lake.

The respiration of the lake, like that of the higher animal, may be divided into external and internal respiration. By the former we understand the absorption of certain gases from the air and the return of other gases to it, as well as the processes by which this exchange is effected. We include in it also the methods by which the gases are distributed in the lake and conveyed to and from the surface of the water, which takes them from the atmosphere and gives them back to it. By internal respiration we mean the gaseous exchanges which take place in the lake itself, between its various organisms and the water surrounding them. With these exchanges come the chemical processes by which the character of the gases is altered or new gases manufactured, in the course of the vital activities of the inhabitants of the lake.

The external respiration of the lake closely resembles that of the organism. The lake absorbs oxygen, carbon dioxide, and nitrogen from the atmosphere and returns to it nitrogen, carbon dioxide, and sometimes other gases. The nitrogen absorbed by the lake, like that taken in by an animal, has very little or nothing, to do with the vital processes. In autumn, as the lake cools, larger amounts of nitrogen are absorbed, according to the general law of absorption of gases. As the lake warms during the summer season, the capacity for holding gases in absorption becomes smaller and some of the nitrogen is lost. This process is a purely physical one and has apparently no influence on the life of any of the organisms whose home is in the water.

The relation of the oxygen to life is, however, far different, and the processes of external respiration are of prime importance to the living beings of the lake. Speaking roughly, and in terms of our comparison, we may say that an inland lake is an organism which takes one full inspiration in the fall, and another, less complete, in the early spring; that during the winter it

does not breathe at all and during the summer has only a very shallow and imperfect respiration. As the lake cools in the fall the temperature becomes uniform from top to bottom at a date which will vary from late September to late November or early December, according to the area and the depth of the lake and the consequent temperature of the bottom water, the volume of water to be cooled, and the vigor of the cooling processes. When the temperature has thus become uniform, the water of the lake is readily moved throughout its entire depth by the wind. It is turned over and all parts of it are brought into contact with the atmosphere. As a result, inland lakes, even those whose depth is two hundred feet or more, become almost, or quite, saturated with oxygen at a temperature but little above the freezing point. This quantity amounts to about 10 cc. per liter, or about 1 per cent by volume; nearly twice as much as the water will hold at the highest summer temperature. In this condition as regards oxygen the lake goes into winter quarters, becomes covered with a sheet of ice in our latitudes, and is, therefore, shut off until spring from all further direct connection with the atmosphere. During this period the stock of oxygen is used up to some extent, especially in the water adjacent to the bottom. But as the vital processes of both plants and animals, and also those connected with decay, go on slowly at the low temperature of the water in winter, the amount of oxygen thus consumed is comparatively small, and most lakes contain an abundance for all forms of life at all depths, except perhaps in the strata very close to the bottom. This statement, though generally true, will not hold universally: In some ponds which are shallow and contain a large amount both of living organisms and of decomposing matter, the oxygen beneath the ice may become wholly used up. We all know of lakes, which become so poor in oxygen that if a hole is cut through the ice in late winter, the fish will crowd to it for air so eagerly and in such numbers as to be forced out on the ice. There are on record cases where an unusual exhaustion of the oxygen below the ice of a lake has caused the death of most of the fish. Such cases, however, are not common, and in the great majority of lakes the consumption of oxygen in winter does not go far enough to affect unfavorably their living inhabitants.

Associated with this partial exhaustion of oxygen, there is an increase during winter of the amount of carbon dioxide—the main gaseous product of respiration. This is not present in any observable quantity in the lake at the time of freezing but it increases during the winter and the quantity at the bottom may become very considerable. The amount will be, in general, proportional to the amount of oxygen used up.

In the spring, when the ice has melted, the water of the lake is once more uniform in temperature. It is put into motion once more by the wind and all parts of the water are brought into contact with the air. The carbon dioxide, which has been accumulating during the winter, is discharged and the lake again becomes nearly saturated with oxygen. But, as the temperature in spring is higher than in the autumn, the amount of oxygen taken in is less; and since the temperature of the water continues to rise, the stock of oxygen is being diminished from this cause quite independently of any use made of the gas by the organisms of the lake.

The period of full oxygen saturation in the spring is a very brief one in our climate. The season advances rapidly and the surface water soon acquires a higher temperature than that at the bottom. This warmed water is, of course, lighter than the cooler water below and tends to float upon it. The difference in density thus caused makes it increasingly difficult for the wind to create and maintain a complete circulation of the water. For a time the action of the wind may continue to mix each successive stratum of water with that below it, the mixture extending to the bottom of the lake. But this action is a very different thing from the complete overturning of the water, and while it results in raising the temperature of the lower water, it does not carry freely oxygen to the bottom. Thus, when the surface becomes decidedly warmer than the water below it, the bottom water, though it continues to warm, is withdrawn from direct contact with the air and is therefore at a disadvantage in the matter of gaining a new supply of oxygen.

As the season advances this stratification of water dependent on temperature becomes accentuated, and, in the way of which I spoke last year and need not now repeat, the lake becomes separated into two parts: an upper warm stratum of nearly uniform

temperature, beneath which lies the cold water, consisting of a transition layer—the thermocline—in which the temperature is rapidly falling, and below this the mass of the cold water, whose temperature ordinarily falls rather slowly with the depth until the bottom of the lake is reached. The thickness of the upper layer varies with the size of the lake, from ten or twelve feet to thirty or forty feet. It is present as a definite and permanent layer at a date varying with the area of the lake from late April to the middle of July. It increases in thickness after the cooling of the lake begins but does not change much before that process commences.

This upper layer is subject to the direct action of the wind; is kept in circulation, and may be saturated with oxygen, or nearly so; but the only new supply of oxygen which the lower water can gain must come to it indirectly from the upper stratum. This condition of permanent stratification of the water comes on at the time when the life of the lake and its consequent need for oxygen are rising to the maximum, with the increasing warmth of summer and the development of life. The consumption of oxygen for the purposes of decomposition is also at a maximum. The separation of the lower water from the atmosphere in summer by a thick layer of warm water is therefore a much more serious thing than the separation of the water from the air in winter by ice. In winter the demand for oxygen is at a minimum and the stock contained in the water is at a maximum. In summer both of these conditions are exactly reversed. It is therefore necessary for us to inquire as to the means which the lake has for absorbing oxygen from the air and its means of transporting the gas from the surface to the place where it is to be used, and to note the efficiency of these processes as compared with the call for oxygen in the summer life of the lake.

The absorption and distribution of oxygen constitutes one of the fundamental problems of life for any large and active organism. The difficulty of solving the problem is increased by the fact that no large reserve stock of oxygen can be maintained. In the case of a human being there may be a food supply in the tissues sufficient to sustain life for weeks, even though no new supply is taken in. There is water enough in the body to main-

tain life for days; but if the supply of oxygen is shut off, life can be continued only for a very few minutes on the stock of oxygen contained in the body. So narrow is the space between abundance of oxygen and death from oxygen starvation. In a cold-blooded animal—with which the lake ought to be compared—processes of respiration are slower but the relative situation is not materially different. The result of these conditions is that in any large animal enormous surfaces must be provided for the absorption of oxygen and there must be a perfect mechanism for its distribution. Such respiratory systems exist in a great variety of forms, many of which are extremely complex and efficient. In the case of man the absorbing surface of the lungs is said to amount to about two thousand square feet—an area as great as the combined surface of floors, walls, and ceiling of a room 20 feet square and 15 feet high. The necessity for arrangements for a large absorbing surface increases with the size of the animal, since in a large organism the area of the general surface is far smaller in proportion to its mass than in a small organism of the same shape. In a lake, whose size is enormous as compared with that of any living being, the absorbing surface is very small as compared with its mass; being only the upper surface of the water. The lake is, therefore, at a great disadvantage in the matter of absorbing oxygen as compared with the animal. Still further, all higher animals, both cold-blooded and warm-blooded, contain in their blood some chemical substance which has a special affinity for oxygen and which can rapidly pick up large quantities of it. Such a substance is wholly lacking in the water of the lake, whose respiratory power is correspondingly smaller, both as regards the rapidity with which oxygen can be taken up and the amount which can be absorbed. It is indeed true that water will absorb, according to the general laws of the absorption of gases, about twice as much oxygen as nitrogen under similar conditions. This fact allows the lake to take in a larger stock of oxygen than would otherwise be possible, and that part of the atmosphere which is dissolved in the lake contains about one-third oxygen instead of one-fifth, as is the case outside. But even this amount is very little in comparison to the enormous volumes which a substance like haemoglobin can take up. It is also true that the mass of the water of the lake, in

comparison to the mass of the organisms which draw their oxygen from it, is relatively far greater than the mass of the blood with reference to that of the cells which take their oxygen from it. Yet is it none the less true that the supply of oxygen in most lakes is very small as compared with that of an animal, and the mechanism for renewing it is always very inefficient as compared with the demand for the gas.

The disadvantage of the lake in the matter of respiration appears still more clearly when we consider the means of transporting the oxygen from the region where it is absorbed—the surface—to the deeper parts of the lake, where much of it is to be used. The animal shows a complex and very efficient mechanism for the circulation of the blood; an apparatus whose complexity and efficiency are in large measure determined by the necessity for a rapid distribution of the oxygen and a rapid disposal of the gaseous wastes of the body. In the lake the means of transport are three: diffusion, by which the gas is slowly passed from point to point in the water independently of the currents; currents produced by the wind; and convection currents, produced by the cooling of the surface water to a temperature below that of the water beneath.

Diffusion is a process which operates rapidly when the distances are minute, but whose efficiency decreases greatly as the distances increase. In our lungs, or the gills of a fish, for instance, where the distance between blood and air is measured in thousandths of an inch the process of diffusion goes on with great rapidity. But where, as in the lake, the distances are measured by inches or by feet, or even by scores of feet, the process is practically worthless for the processes of distribution. By diffusion alone oxygen would penetrate the lake only to the depth of a very few feet in a whole season. While diffusion, therefore, plays an active and important part in the exchange of gases between the individual plant and animal and the water immediately surrounding it, it has little or nothing to do with the general circulation of gases within the lake.

During the fall, when the lake is cooling, convection currents aid materially in carrying oxygen down to considerable depths. The surface water, saturated with oxygen, cools, becomes heavier, and sinks, carrying the gas with it. The same

process takes place at night in summer, but ordinarily to very small depths. In general, we may say that during early and midsummer, before the period of general cooling begins, these processes do not extend to greater depths than ten or fifteen feet. At the season, therefore, when vital processes are most active and the need for oxygen is greatest, convection currents afford a minimum of assistance in distributing it. The main reliance, therefore, for the distribution of oxygen is in the third factor, the wind. This, as already said, is very efficient when the lake is uniform in temperature; but during the spring, as the lake warms, it becomes increasingly ineffective and during the summer its action is confined to the upper warmed layer of the lake, and the lower, cooler water is wholly shut off from the direct influence of the wind currents.

These facts show that an inland lake has an extremely inefficient apparatus for absorbing and distributing oxygen and the net result is that in many lakes the amount and character of the higher life which the lake will support are conditioned by the amount of oxygen which the lake contains rather than by the amount of food which it can produce. The oxygen in the lower and cooler water of the lakes cannot be renewed between spring and fall. This amount would be indeed ample to sustain a large amount of animal life in full activity. But its use cannot be confined to the necessities of ordinary life. The processes of decomposition draw upon it much more heavily than does the animal or the ordinary vegetable life. All the plants and animals of the upper water, which die and sink into the deeper strata, the leaves blown into the lake, and the material washed in from the shore, decompose in the cooler water and in the process of decomposition use up a great amount of oxygen. This depletion of the stock of oxygen goes on with a rapidity which varies with the amount of decomposing matter dropping into the lower water; with the temperature of the lower water, which to some extent regulates the rapidity of decomposition; and with the depth of the water, on which depends the quantity of oxygen contained in it. Each of these factors may and does differ in different lakes, but the result is that in a very large proportion of our inland lakes the bottom water loses its stock of oxygen comparatively early in the season and becomes un-

inhabitable for higher animals. This fact excludes from our lakes a good many kinds of animals which they might otherwise support, and very greatly limits the quantity of the higher life which the lake is able to maintain. A lake which loses its bottom oxygen, for example, cannot support a fish, as the lake trout, which must retire to the deeper and cooler water during the summer. To such causes may probably be attributed a considerable number of our failures in the planting of fish in our inland lakes. From causes such as these, the whole of the lower water, containing half, or more, of the volume of the lake, may become uninhabitable during the season when life is most abundant; and the quantity of life which the lake supports may be correspondingly limited.

Still further, since the rapidity with which the oxygen is exhausted depends on the amount of material which is deposited in the lower water, those lakes whose upper water contains the greatest quantity of vegetable life, and which can therefore support the greatest amount of animal life, use up the oxygen of the lower water most rapidly. It looks, therefore, as if we were in a somewhat unfavorable situation as regards the possibilities of higher life in the lower water of inland lakes. Those lakes whose food supply is such that they are capable of supporting large quantities of animal life—I may say for our purposes, large numbers of fish—are likely from that very fact to exhaust the stock of oxygen in the lower water, which thus becomes uninhabitable; while those lakes whose lower water is fully habitable are likely to be so poor in organic life that they can support only a limited number of fish. It may be that further study will show that this relation is not so unfavorable as it now appears, but at present we must face the probability that it exists.

A noteworthy exception to this statement should be made in the case of very deep lakes—lakes two hundred or more feet in depth—in which the quantity of the lower water is so great and the consequent amount of dissolved oxygen is so considerable that no ordinary amount of decomposing material can exhaust it or materially reduce it. This is the case, for example, with Green Lake (237 feet in depth) in Wisconsin, and the same statement would doubtless hold for the deep lakes of New York

and similar bodies of water. Such lakes may support an abundant population of fish both in the warmer and the cooler water. If they do not do so, the fault does not lie with the oxygen supply.

Thus we see that if we desire to determine the capacity of a lake for the development of higher life, we must consider not only its capacity for food production but also its respiratory conditions. It may be that an imperfect respiratory mechanism renders a very large share of the bottom of the lake wholly uninhabitable for animal life; that while, for instance, mud-living insect larvae may be found in the mud around the lake to a depth of twenty or thirty feet, they are excluded by the absence of oxygen from the entire bottom of the lake beyond this depth, an area of perhaps many square miles. The supply of food which the lake offers to the higher animals may thus be greatly limited by the lack of oxygen. It may be true also that the greater part of the volume of the water of the lake is uninhabitable for similar reasons, and that a lake whose surface appearance would indicate that it is capable of supporting enormous quantities of fish life may be very considerably restricted in this respect by its respiratory capacity. Each lake should be studied both as to food and oxygen if an intelligent economic use is to be made of its waters; and when this is done, the possibilities of use will often be found to depend on the respiratory mechanism.

I have said nothing on another side of the methods of absorbing and transporting gases in a lake. The same processes which take oxygen from the surface bring waste gases to it and they are as efficient or as inefficient in the latter process as in the former. Processes of absorption and transportation have much to do with the story of the complex relations of carbon dioxide gas in the lake. These matters, however, can better be spoken of under internal respiration. I need only say here that the accumulation of waste gases in the lower water does not seem to affect life unfavorably if there is plenty of oxygen present also. Respiratory inefficiency limits life in a lake because of lack of oxygen rather than because it allows poisonous gases to collect in large quantities.

The subject of internal respiration deals with the changes

of gases within the lake itself and with the manufacture of gases by the organisms which inhabit it. No branch of physiology is more intricate and none less understood than is that of internal respiration. This is true also of the internal respiration of the lake. The gaseous exchanges and the manufacturing operations in the interior of a lake are far more complex than those of any animal. From the water living beings are drawing supplies of gas, each after its kind, and to the water each is contributing gases differing in amount and composition. Animals are withdrawing oxygen from the water and giving carbon dioxide to it. Algae are repeating this process by night and exactly reversing it by day. Fungi and bacteria are using oxygen in the course of their internal vital activities; they are employing far larger quantities in the fermentative processes which they maintain. The numberless chemical changes included under decomposition and fermentation, going on under all sorts of conditions, involving numerous kinds of materials, and operated by various organisms, are adding to the water gases of different kinds and in varying proportions. The upper water, the lower water, and the mud present very dissimilar fields of work to the organisms which inhabit them. It is, therefore, impossible even to attempt a picture of the internal respiration, with the innumerable operations, each adding to or subtracting from the sum of gases in the lake; in an intricate network of processes, consecutive, correlative, and antagonistic; connected by relations which cross and interlock at a thousand points. I shall speak of only a few detached topics.

I have said that the oxygen of the lake is absorbed from the air. This is true so far as the main stock of oxygen is concerned; but a lake has a second source of oxygen which is always considerable and which in certain places and relations may become important. The green plants which inhabit the lake are able to take up carbon dioxide from the water, and under the influence of light they can use it in the manufacture of starch, setting oxygen free in the process. In lakes which contain an abundance of algae, considerable quantities of oxygen may arise from this source and this manufactured oxygen may play an important part in the vital history of the lake.

Consider the effect of the addition of this power of the algae

to the numerous factors which are affecting the supply of oxygen in the upper water of the lake in summer. If the oxygen of this region is studied, it rarely happens that the quantity found is the amount which would be theoretically expected, according to the laws of the absorption of gases by water at different temperatures. It is sometimes largely in excess of the theoretical amount, and sometimes is considerably deficient. The fact is that the amount of oxygen in the upper water of the lake is the result of very numerous and variable forces. The lake may or may not be absorbing oxygen from the air. If saturated, it will give off oxygen to the air as the water warms, or will take it in as it cools. Both of these processes go on somewhat slowly, as the oxygen is not given off or absorbed as rapidly as the rate of cooling and warming varies. Into the water the green plants are discharging oxygen during the hours when the light is sufficiently strong; from the water both plants and animals are taking oxygen to assist their vital operations; and the process of decomposition is aiding to exhaust the stock of oxygen. Thus the amount present at any given moment will depend on the relative value of these forces; some of them positive; others negative; and all varying not only from day to day but from hour to hour. Nor do these factors exhaust the list. The wind has something to do here. During a calm period the oxygen content of the upper water may differ from that of a stormy period. The vital condition of the successive crops of algae, as they come and go, may determine for the time, the predominance of the manufacture of starch, with accompanying liberation of oxygen, or decomposition, with partial exhaustion of oxygen. Thus the ability of the green plant to set free oxygen into the upper water may be of great value in maintaining the supply of the lake.

This power may be far more important in the lower water. If the transparency of the water and the thickness of the warm layer are such that a good deal of light can penetrate to the colder water, algae will be able to manufacture starch in the upper part of this stratum. Thus in the region which is practically cut off from access to the atmosphere, large amounts of oxygen may be set free. There may be enough not only to serve the ordinary needs of the stratum, but the water may be satur-

ated or even over-saturated with the gas. I gave several instances of this process in my address last year and need not repeat them at this time. I give the diagram of Elkhart Lake

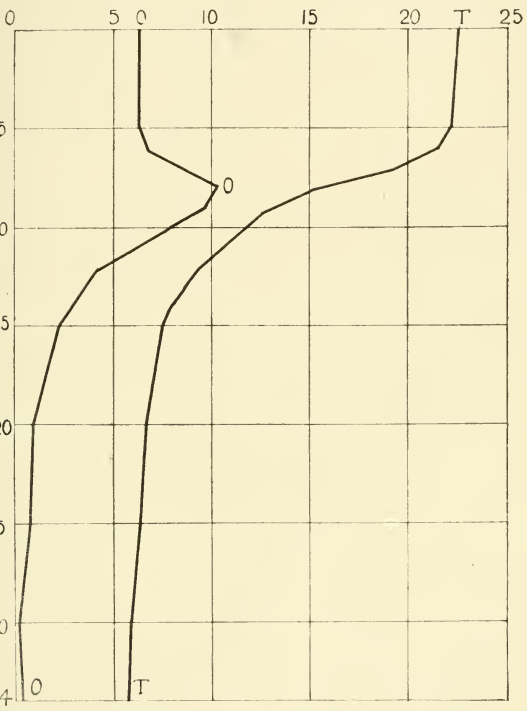


FIG. 1. — Elkhart Lake Aug. 23, 1905

This diagram represents the condition of Elkhart Lake with respect to temperature and oxygen. The vertical spaces represent meters of depth. The horizontal spaces represent two things: (1) degrees centigrade, as indicated by the temperature line (T—T); and (2) cubic centimeters of oxygen per liter, as represented by the oxygen line (0—0); or the oxygen is indicated as parts per thousand, by volume. It is easily seen that the temperature of the water begins to fall rapidly at about 6 m. and that the oxygen begins to rise rapidly at that depth, reaching a maximum of more than 10 cc. at 8 m., and decreasing from that depth. A very important addition is made to the oxygen stock of the lake by this manufactured gas.

from that paper, which shows clearly the position and amount of this manufactured oxygen, and the addition which it makes to the thickness of that part of the lake that has abundance of oxygen. Lakes whose habitable portion would otherwise be only twelve to twenty feet in thickness may have this depth doubled by the presence of the manufactured oxygen. The plants in this undisturbed cooler water find a peculiarly favorable situation for growth. They obtain for their food the products of decomposition, which is taking place rapidly in the lower water; and not infrequently a far larger amount of organic life may be found in these strata than in any other portion of the lake. This process is necessarily limited to lakes whose upper warm layer is thin, and is confined to the upper part of the cold water, since only there can the light have sufficient intensity to carry on the operation. But even as thus restricted, it is of great value to some lakes.

I have said little hitherto of the carbon dioxide—a gas whose importance is quite equal to that of oxygen—and now can only sketch a part of its complex story. This gas plays many roles in the respiration of the lake. It is at once the waste product of the tissue activity of plant and animal, the product or by-product of decomposition, and the indispensable food of green plants. The lake may obtain the gas from the air, and to some extent does so. Carbon dioxide exists in the atmosphere in very small amount—about four parts in 10,000. Minute as this quantity is, the land plants are able to secure from it ample supplies of carbon. The movement of the air is so free and such enormous quantities pass over the surface of the plants, that they readily pick up the gas in large amounts. But the situation of the algae and other plants of the lake is very different, as they must secure their carbon dioxide through the intermedium of the water. This readily absorbs large quantities of the gas. But the percentage existing in the air is so small, the absorbing surface of the lake is so restricted, and the means of transport are so poor that the lake is quite unable to take from the air enough carbon dioxide to maintain a vigorous growth of plants. The lake is forced to depend on its own resources to a large degree for this plant food. Fortunately, these resources are considerable. Great amounts of carbon dioxide are manu-

factured in the lake as the result of decomposition and these may be utilized as food by the green plants. Thus there is kept up in the lake a sort of internal circulation of carbon dioxide; the stock of the circulating medium being increased and replenished by additions from the outside. The activities of animals and the processes of decomposition liberate the gas, which is taken up and manufactured by the plants into organic substances; and these in turn serve as food and as material for new decomposition; while from the air the water may be absorbing new supplies of carbon dioxide to make good the losses of this process. Thus under normal conditions, the lake would return little or no carbon dioxide to the atmosphere, but would utilize within itself all that it manufactured or absorbed, at least until the plant life became so abundant as to be limited by other causes than that of food supply.

If this were all, the story would be quite simple and quite to the advantage of the lake. But it is by no means all the story; on the other hand, so far from being forced to solve problems associated with an oversupply of carbon dioxide, the lake has to encounter many difficulties in securing an adequate supply of that gas, and is able to meet them only very partially and imperfectly. Since the plants are able to utilize carbon dioxide in the manufacture of starch only during the hours of sunlight, considerable quantities may escape into the atmosphere during the night. But this is not the only disadvantage as regards the supply of carbon dioxide, with which the plants of the upper water have to contend. By no means all, or even the greater part of the organic matter which they manufacture decomposes in the upper, warmer stratum of the lake. As the plants and animals die, they sink into the lower and cooler water before any great part of the decomposition has been completed. The carbon dioxide which is there produced is discharged into this bottom water. It cannot be used there by plants on account of lack of light; and the same imperfections of transportation which prevent the access of oxygen to the cooler water in summer make it impossible to transport the carbon dioxide produced there to the upper stratum, where it can be utilized. In certain lakes, indeed, a small portion of this gas may be used in the cooler water, as I indicated above, but, in general, the upper water, as a result of

this process, is growing poorer during the summer in the materials on which plants feed, both gaseous and other. These are for the time locked up in the lower water and so withdrawn from the circulation of life. In the autumn, as the lake cools and the thickness of the circulating stratum increases, these matters become available so far as they lie in the upper part of the cooler water, and when the lake has become uniform in temperature to the bottom, and the water is turned over by the wind, the whole of this accumulated stock is available for the purposes of plant growth. This may be one of the reasons for the abundant growth of algae, which takes place in the autumn. But while the non-gaseous products of decomposition may be wholly utilized in the lake, the carbon dioxide is hardly likely to find full use. When it once becomes distributed through the water and new portions of the water are being continually exposed to the air, considerable quantities must escape during the hours when plants are unable to avail themselves of it.

Thus the rudimentary character of the circulatory apparatus of the lake forms an insuperable obstacle to the best utilization of their food supply. It is therefore easy to see why life is relatively so abundant in large and shallow lakes, in which the circulating methods have a maximum efficiency. The fact that they are shallow permits a larger growth of life, since not only is the water available but plants in large quantities may grow from the bottom. But of even more importance than this relation is the fact that since the entire mass of water is kept in circulation by the wind, all of the products of decomposition are immediately available for use and the life cycles of the plants may go on as rapidly as their rhythm of growth will permit. The carbon dioxide and other products of decomposition, instead of being locked up in the deeper water and set free only during that season which is less favorable for growth, are utilized immediately and are employed over and over again through the warmer season as the cycles of life and death of the individual plants recur. It is plain that lakes whose margin is wide and shallow, though the middle may be deep, must stand next to the shallow lake in efficiency of means of transportation. Much growth takes place in shallow waters, much decomposition goes on there, and little of the organic matter sinks into the deep

water, to be withdrawn from circulation. Least favorably situated is the deep and steep-sided lake, whose cold depths are continually swallowing almost all of the products of the summer's growth, and give them back for use, only late in the autumn when the season for active life is passing away.

Some lakes may find aid from another source in the task of securing carbon dioxide. Most natural waters contain a certain amount of calcium and magnesium salts in solution, and, for the greater part, these exist in the form of bicarbonates. Lakes whose water is hard contain a considerable amount of these bicarbonates and soft-water lakes have little or none. In hard-water lakes it is found that during the growing season, when algae are active, the upper water contains no free carbon dioxide, but is, on the contrary, alkaline to indicators like phenolphthalein. This alkalinity comes from the fact that one molecule of carbon dioxide has been withdrawn from part of the bicarbonates converting them into carbonates. It appears that the algae are able to effect this reduction and that they can obtain their supply of carbon from the carbon dioxide of the bicarbonates dissolved in the water. This fact introduces a wholly new feature into the story of the food supply of the plants. It provides a chemical carrier for the carbon dioxide, which may carry this gas somewhat as the haemoglobin carries oxygen in the blood. All carbon dioxide set free in this alkaline water as the result of decomposition or other processes, will be taken up immediately by the carbonates. Thus if plants are not at hand to utilize the carbon dioxide at once, it is not lost but kept until it is needed. So in the night, the lake is able to retain all the carbon dioxide set free and which the plants do not use at that time.

Such alkaline water has also a great advantage in absorbing carbon dioxide from the air. It presents for absorption, not merely the relatively weak and slow powers of the water for dissolving the gas, but the eager and vigorous powers of chemical affinity. And until these alkaline carbonates are saturated, no free carbon dioxide will appear in the water to diminish the rapidity of absorption from the air. Thus hard-water lakes have an advantage over soft-water lakes in the matter of securing plant food, and in fact the population of soft-water lakes seems to be smaller than that of lakes of the other type.

It is worth while to devote a few words to gaseous products of decomposition other than carbon dioxide. So long as the bottom water contains an abundance of oxygen no other gas than carbon dioxide is produced in appreciable quantities. But as the oxygen becomes greatly reduced or wholly disappears, decomposition continues in new forms, and under these conditions of anaerobic fermentation other gases may be developed in considerable amount. It is apparently true that carbon monoxide may be present in the lower water of lakes in appreciable quantities, and it is certain that marsh gas is developed in large volumes in lakes where the amount of fermentable material is great and where the oxygen dissapears from the lower water early in the season. These gases first appear near the bottom, where decomposition is going on most actively and where oxygen first disappears. In many lakes they are found only in small quantities and close to the bottom, but in proportion as the amount of decomposable matter increases, they are found at considerable distances from the bottom, and in certain lakes all of the water below the thermocline may contain marsh gas in appreciable quantities, often becoming very great as the bottom is approached. These gases do not seem to have any very definite unfavorable effect on the life of the lake. Diffusion is so slow that they do not reach the upper water and experiments indicate that their presence in the lower water adds little, or nothing, to the unfavorable conditions brought about by the absence of oxygen.

It should be noted that these processes involve a loss of meterial for plant food. Carbon dioxide, produced by aerobic decomposition, is available for plant food in the lake, or, if not there, then elsewhere as part of the general stock of that gas in the atmosphere. But marsh gas has no such relation to plants and all substances converted into it are lost to the cycle of life. Its production means just so much reduction of the food supply of the lake. The same may be said of the carbonized, peat-like substances produced from the partial decomposition of plants under water. So long as these remain under water, they are practically withdrawn from the food supply. Against all these influences which tend to diminish the stock of food for its inhabitants, the lake is contending, but with imperfect means and only partial success.

I have thus hastily and imperfectly sketched the respiration of an inland lake, not because the story is known with any fullness or completeness, but partly because our present knowledge, imperfect though it is, shows that the subject is one of great scientific interest; partly also because many practical hints regarding the utilization of lakes in fish culture can come from our knowledge of respiratory conditions. We are accustomed to think of the food producing capacity of the lake as the factor which determines the kind and amount of the crop of fish which it can produce. It is a somewhat new thought to me, and I have no doubt that it is equally new to many of you that the respiratory capacity of the lake may have even greater influence in this matter than has the capacity for the production of food. Yet it is plain that such is the case and that a knowledge of the respiratory conditions of the lakes in which our fish are to be planted is necessary if the best results are to be reached.

DISCUSSION.

Mr. Titcomb: I just want to say one thing in connection with the question of "Respiration," and that is the use of the outlet of a lake as a water supply for fish culture purposes. Dr. Bean in his enumeration of a few of the troubles, mentioned the fact that it was difficult even in the state of New York to find suitable water supply. Now, I have always entertained the theory that to get an abundant supply of water for an immense trout hatchery, perhaps larger than any in existence, the outlet of a lake would be the proper source. Dr. Birge brings out again, as he did last year, some of the difficulties to be encountered. At the same time, I think that his investigations, or investigations along the same line, would definitely determine whether it is safe to use the outlet of a lake. In other words, in the summer time, we wish to get an abundance of cold water. Now, the question is, whether we can go to a lake and draw the water from a certain depth to get cold water, and at the same time get water containing the proper amount of oxygen. I infer from his paper, that it can be easily determined at what depth we can depend upon a certain temperature of water and at the same time determine whether the water at that depth contains sufficient

life to hatch and rear young fish. I think that is really a very valuable point to be considered in connection with this investigation.

President: That can very readily be determined. Of course if you are willing to take the surface water, that is all right.

Mr. Titcomb: That is usually too warm.

President: If you want the deeper water, you will have to consider several questions. If you want a very large supply, you will have to consider the question as to whether there is sufficient water in the lake to give you water of that temperature, because you will find that the supply of water in the lower part of the lake is in ordinary cases extremely small. We have done a great deal of work on lake temperatures, which I hope to have published during the year. Now, we find that there are very few lakes indeed where the bottom temperature during the winter rises to an appreciable extent in a way which can be attributed to ground water. This means that very little water is getting into the lake from the ground, since the lake temperature goes down to 2° or 3° C., and the temperature of the ground water in our latitude is somewhere about 8° C. Almost all water coming into the lake, comes in the upper part above the water level, or immediately below it, and the idea which so many people have that there are great springs down in the bottom of lakes is entirely erroneous. In an open sand region, where there is comparatively little clay near the lakes, there may be the same kind of slow circulation through that sand bottom that there is through the general water-bearing strata of the country, but in most lakes the bottom is covered with a very impermeable layer of mud. We were working on the winter temperatures of Lake Mendota last winter. We had a pipe about twelve feet long, and drove it down into the mud in sixty or seventy feet of water, so that we got a section of mud; we could not get more than five feet of mud to come up in the pipe; that was just as sticky as hasty pudding. There was practically no seepage of water through it; so that the entrance of water into the deeper part of the lake is slight. If you wanted a small supply for a hatching trough, that would be all right;—but if you wanted water on a large scale, to supply a trout hatchery in that way,

you would have to consider carefully whether the lake would stand that drain upon it, because by far the greatest source of water is at the surface and immediately below the surface.

If you will go to a lake in August or September, and determine the question of temperature and gas, which is a very easy thing to do, that will tell the story.

President: Is there anything further in this matter?

Mr. Seymour Bower: It is a very important paper and has a great deal of practical value. I think the planting of a great many of the fish which we are now planting might be avoided. We plant a good deal of lake trout by eggs.

President: I believe that if you are going into planting lake trout or whitefish in any inland lakes, it would pay you to have the lakes examined before you put the fish in; but I hope to be able to say that positively next year. Last year we did this, which shows you something about it. You know the black fin, which is the common whitefish of our inland lakes (*nigripennis*), it has been said goes to the bottom in summer. Now unless it goes into the mud like a frog in the winter, it cannot go down, because these lakes have no oxygen in the bottom water. We were working on one of the lakes in northern Wisconsin, a lake about fifty feet deep, and we happened to set our gill net right across this point in the lake where the cool water begins. The inner end was in the warm water, and the outer in the cool water, and when the net was taken up, there were perhaps eight or ten of these black fins, and they came from the lake just at this junction. Now it seemed to us that this showed, as well as one experiment could show, the fact that this fish was living in water which was just as cold as it could find oxygen in. So that there would be only a pretty limited area in that lake in which that fish could live.

Mr. Clark: On account of the temperature of the water—did that have something to do with it?

President: They would not come up in the warm water any more than was necessary. They probably liked the cold water. But they would go down into the cold water as far as they could.

They would not be shut out of the lower water by the temperature.

Mr. Clark: Mr. President, some years ago, I had just that same experience in making some investigations in a small lake in Oakland County, Michigan, in Walunt Lake, and that was in November, and the gill net was set not on shore, but in perhaps five or six feet of water, and run out several rods—I could not give you the distance; we caught thirty whitefish, six lake trout and one pike perch. The whitefish were in the net in not over twenty feet. They were bunched right in, and the lake trout were right just above them, and the one pike perch was above.

President: We had this experience with lake trout. We went to a lake in northern Wisconsin, known as Trout Lake, which I wrote of in the paper I published in the last transactions, although the lake was examined after the meeting. We set our net there in the deepest water, very close to a hundred feet, and after it had been set, we went out and determined the oxygen right down to the bottom of the water, and found oxygen there. On hauling the net at the same time, we found a number of lake trout in the net at that depth, so they were in the very bottom of the lake; as a matter of fact, they were in the bottom part of the net, though I do not suppose that had any special significance; they might have moved down as well as up; but they were in as deep and cold water as they could find.

Mr. Clark: That was the reason they were there, trying to find that cold water.

President: The net did not extend from warm to cold water. This was wholly into the deep water.

Mr. Carter: Is there any way to determine how much oxygen there is? Can you tell us?

President: We have used the Winkler method of testing for oxygen, if you know that.

Mr. Carter: I don't know anything about it at all.

President: I am ignorant of chemistry, yet I learned in half an hour to use the test, and think anybody else can. It is one of the standard methods in the books. We use a pump and

hose to bring the water up, which has to be mixed with various chemicals. When you come to the actual test the amount of the solution to be used varies with the amount of oxygen originally present in the water. The proper amount can be determined very accurately because the color of the water changes when enough of the solution has been added, and from the amount used it is easy to determine the amount of oxygen present.

Mr. Clark: I would like to ask the president if Professor Hawkinson has published his report.

President: Professor Hawkinson has not, at least I suppose not, I haven't received it.

Usually the lakes in Wisconsin which carry oxygen to the bottom have shown very sparse bottom life and from the reports I have received from Mr. Wagner, who is looking up the fish, that seems to be true in the additional lakes he has examined this season.

Mr. Lydell: Would it be possible for a practical fish culturist to take the apparatus and find out whether there was oxygen, without a scientist to tell him?

President: If I had the apparatus, I could show anybody how to use it.

Mr. Lydell: This paper was very interesting to me. Lots of times, while raising nets while on examination of state waters, we would find, as the net would drop off into deeper water, the fish would shut off instantly. Last season, the commission sent me to one of the lakes to find if there were any wall-eyed pike there. I had supposed the wall-eyed pike would be in deep water, but did not find any. I have found out now why I did not find them.

President: The only trouble with your investigation is that if you are going to do it, you must carry a pump and hose, a number of bottles and so on, and it is a good deal of a nuisance.

(A Voice: It depends on the bottle.)

President: These are a different kind of bottles.
(Laughter.)

THEORY vs. PRACTICAL TESTS

BY J. J. STRANAHAN, OF BULLOCHVILLE, GA.

It had not been my intention to prepare a paper for this meeting, but a little reflection has changed my mind.

I take it for granted that the question of large and small fingerlings in black bass planting is settled in favor of the latter, or rather in favor of both, but even if it is, a few words on this side of what was at one time a controversy, may prove interesting if not instructive.

The Cold Spring, Ga., station of the bureau of fisheries distributed during the fiscal year closing June 30th, 242,000 black bass, of which the major portion was what is known as No. 1 fingerlings, ranging in length from one inch to one and a half inches. This allowed us to cover well the states of Georgia, Alabama and South Carolina, with some shipments for North Carolina and Florida.

If an attempt had been made to supply these hundreds of applicants with large fingerlings, say two to four inches long, we must have signally failed. But it may be urged that the few served with the larger fingerlings would have been better served. This positively would not have been so, as shown by actual results. It will require from 500 to 1000 No. 1 fingerlings to produce 100 No. 3's, and the 500 or 1000 No. 1's will produce far greater and more satisfactory results than the 100 3's. From our past four years experience in planting No. 1's we get only favorable reports. In the neighborhood of the station where we have a better chance for observation, we get reports most gratifying. In the case of new ponds or those newly stocked, the owners bring us reports of the capture of one-year- old bass in greater numbers than it would have been possible to have planted if only large fingerlings had been distributed. From all directions came only favorable reports. Pond building and fish culture interests are greatly on the increase over all the territory that we cover, and there could be no better endorsement than

this of the plan of planting thousands of No. 1's in place of hundreds a little larger.

Our aim is to hold our young bass in the brood ponds just as long as possible and collect them before the school breaks up. This when they are from one to one and one-half inches long, perfectly formed in fin, scale and development and as hardy and easily transported even to long distances, as their larger brothers.

A STUDY OF THE GUANO INDUSTRY AND FISHERIES OF PERU

BY ROBERT E. COKER,

Of Johns Hopkins University, Baltimore, Md.

My object in Peru is to study the guano islands from the biological aspect, with reference to suggesting measures for the protection of the birds and the perpetuation of the guano in-

Shipping guano from S. Island of the Ballestas — altitude about 400 feet or more. The big pile of guano, being sacked, is all new — nests of cormorants made during past breeding season. Is being lowered to a "lancha" which conveys it to a German barge destined for Antwerp. June, 1907.

dustry. Also to make inquiries in regard to the fishes and fishery methods in Peru, with a view to recommendations looking to the development of the fishery industries of Peru. These may seem to be two quite distinct lines of work, yet there is a close relation between them and the Peruvian government has acted wisely in coupling the two studies together at the beginning. Not only is guano actually a fishery product, the birds serving as agents in the fishery, but in regulation and protective meas-

ures the only two classes of people to be considered are the guano workers and the fishermen, and the execution of such measures may efficiently and economically be vested in the same office which may direct the fisheries. In accordance with instructions from the Director de Fomento, I am visiting the most important coast points and the chief guano islands. In the northern region I have made a trip from Callao to Payta (a difference of 7° of latitude), visiting seven coast points and five groups of guano

Cormorants, the birds that make the guano on S. Is. of Ballestas. Only a small part of the flock is in view. June, 1907

islands. At shore points and islands notes are made in regard to the fishes observed and reported and the methods of fishery in use. At the islands attention is given to the abundance and habits of the birds and the relation of birds and lobos. I am now in the Ballestas islands off Pisco in the south and expect to visit in the near future, the Chinchos, San Gallan, the islands of Independencia Bay and such coast points as time allows for.

In addition to the inquires mentioned I am collecting fish, guano birds, and some other forms for subsequent systematic identification of the useful forms.

Fishery. The fisheries of Peru are capable of greater development. The markets of the coast are supplied with some excellent fresh fish but not to the degree, as regards number and variety of fish, to which they may be. The fish of Peruvian waters, in salted condition are appreciated by the inhabitants of Peru and neighboring countries, but the salting industry is

Shipping guano from Ballestas—height 200-360 feet. (Middle island). May, 1907

at present on a most unsatisfactory basis and of an importance far below its possibility.

Some of the methods in use are of interest. The cavallitos or "pony" boats are perhaps well known—a small and graceful boat of reeds on which the Indian fisherman rides astride, as on a hobby-horse, using his hook and lines or working his end of the seine—in most picturesque fashion. The balsas or rafts (large and small) of balsa wood are very serviceable and exclusively used in some regions. On the larger ones, with big sails spread, the fishermen take their families with them to remain out fishing and salting their catch for periods of a number of days. These primitive but useful types of boat are to a great extent displaced now by more modern fishing boats, especially Mediterranean types introduced by Italian and Greek fishermen.

It is interesting to find the selachians valued as food fish,—sharks, rays, angelotas (angel-fish), guitarras (guitar-fish). The guitarras and sometimes angelotas are dried by a process accomplished without the use of salt or other preservative material.

The only important shell-fish marketed is the scollop—crabs are almost unused; the spiny lobster is fished but on a small scale. The comparatively abundant green turtle is quite unappreciated, being scarcely used except for oil for medicinal purposes and for miners' lamps.

Guano. While the ancient deposits of guano are almost exhausted, the industry of the extraction of guano is not to be regarded as a matter of the past. Competent persons estimate the present annual deposit at 25,000 tons or more. I cannot now venture an estimate, but may say that the above estimate gives a fair idea of the present commercial importance to Peru of the guano birds, and I feel assured in stating from observations, that with proper regulation—effective protection of birds and eggs from destruction, observance of closed season, and probably alternate closing of islands, the present available annual deposit may be considerably increased.

By measurements, weights and computation, I have estimated the deposit on the chief breeding ground of this island as over 250 tons of pure guano. Guano extractors here now compute that upwards of 500 tons of *new* guano will be shipped from this island this season—and this is the least important of the three larger islands of this one group.

The important guano birds as so far observed, are in order cormoranta (3 species, one important), pelicans, gannets (2 species). Other interesting bird inhabitants of the island are Larus gulls (two species, one of possible injury to the industry), penguins, the "potiyunki" (a bird I have not taken yet)—the turkey buzzard (injurious in the destruction of eggs and young), and some shore birds. The only mammals I have observed are the lobos, and, in the caves, small bats.

THE NEED OF AN INTERNATIONAL FISHERIES SOCIETY

BY O. T. OLSEN, GRIMSBY, ENGLAND.

There is probably no one present who will hesitate to agree that there is an urgent necessity for the establishment of such a society as the one I now propose. Many congresses are held from time to time, and many matters of interest to the fishing industry are discussed, but unfortunately it is generally found that after the talking is done, and the resolutions are passed, matters deserving a better fate are allowed to drop for the want of a representative international society to make use of the information thus gained. If such a society were in existence, the best results of individual and collective effort might be utilized for the benefit of the fishing industries of the nations concerned. These industries have of recent years developed enormously. So much so that there are those to be found who assert that as a wealth-producing concern fishing has seen its best days. It is a well authenticated fact, however, that the depredations of trawlers are small in comparison with the damage done by the fish themselves. Individual scientists have done excellent work in the past, but it is only of recent years that international investigation has been attempted. Much very valuable research is being made at the present time, but for the full benefit to be enjoyed by the fishing industry, and indirectly by the general public, an international fisheries society is indispensable. It should consist of scientific and commercial men with one common object in view—that is, the well-being of fishing as a commercial undertaking, and its development as a means of providing food. In obtaining the best results commercially the work of the scientist plays a very important part. As time advances it will doubtless be found that this part becomes increasingly important, so that it behoves everyone interested, whether financially or otherwise, to support any proposal leading to the coöperation of science and commerce.

When formed, and in proper working order, such a society

would be in a position to make representations to any government, with a view to reform and introduction of measures calculated to further the interests of all. It would not only be able to make use of the results of the work of others, but it would be a capable and influential body in itself, holding meetings periodically and issuing literature. It should prosecute with energy the study of all matters pretaining to fish life before capture, and after capture to study the best means of converting it to the public use, at all times by means of its literature acquainting its members with its proceedings. To briefly summarise I would give a few heads which would be dealt with advantageously:—

(1.) The natural history of fishes; their use as human food, their migrations and habits.

(2.) The means of catching, preserving and transporting fish.

(3.) Oceanography; the physical condition of the sea; tidal effects; fish hatching.

(4.) Fishery laws; determining the nationality of fishing vessels at sea.

(5.) Fishing vessels and their appliances.

(6.) The qualifications of skippers and mates of fishing vessels, and their examination for certificate of competency.

(7.) Territorial limitations.

These headings, of course, could be extended indefinitely as requirements demanded. Fishing as a sport might be included with a view to the better accommodation of anglers in countries other than their own, working in conjunction with the clubs and societies already in existence for this purpose.

Such a society, with an influential and enthusiastic president, a council composed of men bent on the advancement of the fisheries, and a body of members eager to help one another (and incidentally to help themselves), cannot fail to accomplish its purpose. It would be supported by the subscriptions of its members, and issue its literature in English, French and German. The meetings could be held in several countries in rotation.

Further evidence of the demand for such a Society is not

lacking, and as time advances that demand increases. Perhaps in this audience may be found a few willing to be the nucleus from which the proposed society will be formed, and to whom the thanks of the Fisheries, and indirectly the thanks of the public, will be due.

(Applause.)

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Morgan, H. A., *University of Tennessee, Knoxville, Tenn.*
Morrell, Daniel, *Hartford, Conn.*

Morris, Robert T., M. D., *616 Madison Avenue, New York City.*
Morton, W. P., *Providence, R. I.*
Mountain Lake Camp, *R. F. D. No. 1, Sanbornville, N. H.*
Mussey, George D., *Detroit, Mich.*

Neal, John R., *22½ "T" Wharf, Boston, Mass.*
Neal, L. J., *Mill Creek, Mich.*
Nevin, James, *Madison, Wis.*
Newman, Edwin A., *4305 8th Street, N. W., Washington, D. C.*
Norris, J. Olney, *Room 212, Chamber of Commerce Bldg., Baltimore, Md.*
North, Paul, *Ohio Fish and Game Commission, Cleveland, O.*

O'Brien, W. J., *South Bend, Neb.*
Ohage, Dr. Justus, *St. Paul, Minn.*
O'Malley, Henry, *U. S. B. F., Oregon City, Oregon.*
Orahood, H. M., *1010 Seventeenth Street, Denver, Col.*
Orr, W. J., *Bay Port, Mich.*

Palmer, Dr. Theodore S., *United States Department of Agriculture, Washington, D. C.*
Palmer, Stephen S., *Monticello, N. Y.*
Parker, W. H., *Lac la Peche, Quebec, Canada.*
Payne, Charles, *Wichita, Kans.*
Parkhurst, Hon. C. Frank, *Providence, R. I.*
Partridge, H. E., *Minneapolis, Minn.*
Paxton, Thomas B., *Ohio Fish and Game Commission, Cincinnati, O.*
Peabody, George F., *Appleton, Wis.*
Pennington, Robert, *Wilmington, Del.*
Peoples, Hon. Hiram, *New Providence, Pa.*
Pearce, Captain T. C., *U. S. B. F., Washington, D. C.*
Pope, T. E. B., *U. S. B. F., Washington, D. C.*
Porter, Hon. Richard, *St. Louis, Mo.*
Powell, W. L., *Harrisburg, Pa.*
Prather, J. Hub, *Lexington, Ky.*
Pratt, Joseph Hyde, *State Geologist, Chapel Hill, N. C.*
Preston, Hon. John L., *Port Huron, Mich.*
Price, Andrew, *Marlinton, W. Va.*

Price, Calvin W., *Marlinton, W. Va.*
Proctor, Hon. Redfield, *Proctor, Vt.*

Race, E. E., *U. S. B. F., Green Lake, Me.*
Ramsdale, Frank C., *Bayfield, Wis.*
Randall, G. W., *Plympton, Mass.*
Rankin, J. F., *Ohio Fish and Game Commission, South Charleston, O.*
Rathbun, Richard, *Smithsonian Institute, Washington, D. C.*
Ravenel, W. DeC., *Smithsonian Institute, Washington, D. C.*
Reed, C. A., *Fish and Game Warden, Santa Cruz, Santa Cruz County, Cal.*
Reighard, Prof. Jacob E., *University of Michigan, Ann Arbor, Mich.*
Richards, G. H., *Sears Building, Boston, Mass.*
Rippel, Robert, *Woodruff, Wis.*
Roberts, A. D., *Woonsocket, R. I.*
Roberts, C. C., *Woonsocket, R. I.*
Robinson, Robert K., *U. S. B. F., White Sulphur Springs, W. Va.*
Rogers, J. M., *159 La Salle Street, Chicago, Ill.*
Root, Henry T., *Providence, R. I.*
Rosenberg, Albert, *Kalamazoo, Mich.*
Ruge, John G., *Apalachicola, Fla.*
Russell, Henry, *Detroit, Mich.*

Safford, W. H., *Department of Fisheries, Harrisburg, Pa.* (Life.)
Salmons, Alden, *South Norwalk, Conn.*
Saunders, A. A., *Carolina, R. I.*
Saunders, Dr. H. G., *Chattanooga, Tenn.*
Seagle, George A., *U. S. B. F., Wytheville, Va.*
Sellers, M. G., *1306 Arch Street, Philadelphia, Pa.*
Sherwin, H. A., *100 Canal Street, Cleveland, O.*
Sherwood, George H., *American Museum of Natural History, 77th and 8th Avenue, New York City.*
Shireman, Eugene G., *Martinsville, Ind.*
Shortal, Hon. J. M., *906 Chestnut Street, St. Louis, Mo.*

Shurtleff, Merrill, *Fish and Game Commission of New Hampshire, Lancaster, N. H.*

Simmons, Walter C., *Providence, R. I.*

Singleton, James H., *Woonsocket, R. I.*

Slade, George P., *309 Broadway, P. O. Box 283, New York City.*

Smith, Frank W., *Superintendent Coos River Hatchery, Marshfield, Ore.*

Smith, H. G., *Minneapolis, Minn.*

Smith, Lewis H., *Algoma, Ia.*

Smith, Dr. Hugh M., *U. S. B. F., Washington, D. C.*

Smith, Captain J. A., *13 West 25th Street, Baltimore, Md.*

Snyder, J. P., *U. S. B. F., Washington, D. C.*

Southwick, J. M. K., *Newport, R. I.*

Spencer, L. B., *Superintendent Aquarium, 37 West 128th Street, New York City.*

Spensley, Calvert, *Mineral Point, Wis.*

Stapleton, M. F., *U. S. B. F., Mammoth Spring, Ark.*

Starbuck, Alexander, *Cincinnati, O.*

Starr, W. J., *Eau Claire, Wis.*

Steele, G. F., *Port Edward, Wood County, Wis.*

Stephens, Lawrence de K., *221 Drummond St., Montreal, Can.*

Stevens, Arthur F., *227 West Grand Street, Elizabeth, N. J.*

Stevenson, Charles H., *U. S. B. F., Washington, D. C.*

Stewart, A. T., *U. S. B. F., Northville, Mich.*

Stone, Livingston, *Cape Vincent, N. Y.*

Story, John A., *East Orland, Me.*

Stotz, Martin, *996 N. Marshall Street, Crogin Bldg., Philadelphia, Pa.*

Stranahan, J. J., *U. S. B. F., Bullochville, Ga.*

Stranahan, F. A., *Cleveland, O.*

Streeter, H. R., *Carolina, R. I.*

Sumner, Dr. Francis B., *College of the City of New York, New York City.*

Surber, Thaddeus, *U. S. B. F., White Sulphur Springs, W. Va.*

Sykes, Arthur, *Madison, Wis.*

Sykes, Henry, *Bayfield, Wis.*

Talbot, Henry, *Interstate Commerce Association, Washington, D. C.*

Tankersley, A. S., *Tupelo, Miss.*
Taylor, Robert Kirby, *Westfield, N. J.*
Teal, J. N., *Worcester Block, Portland, Ore.*
Thayer, W. W., *234 Joseph Campau Avenue, Detroit, Mich.*
Thomas, Henry G., *Stowe, Vt.*
Thomas, W. H., *Put in Bay, O.*
Thompson, George B., *Davis, W. Va.*
Thompson, James F., *Martinsburg, W. Va.*
Thompson, William H., *Secretary Anglers' Association of St. Lawrence River, Alexander Bay, N. Y.*
Thompson, W. P., *112 Broad Street, Philadelphia, Pa.*
Thompson, W. T., *U. S. B. F., Leadville, Col.*
Tinker, Eugene, *Corry Hatchery, Corry, Pa.*
Tinker, E. F., *St. Johnsbury, Vt.*
Titcomb, John W., *U. S. B. F., Washington, D. C.*
Townsend, A. A., *Carolina, R. I.*
Townsend, Charles H., *New York Aquarium, New York City.*
Tubbs, Frank A., *U. S. B. F., Neosho, Mo.*
Tulian, Eugene A., *Oficina, Meteorologica, 640 Viamonte, Buenos Ayres, Argentina.*

VanDusen, H. G., *Master Fish Warden of Oregon, Astoria, Ore.*
Venn, Harry S., *Washington, D. C.*
Vincent, W. S., *U. S. B. F., Tupelo, Miss.*
Vogelsang, Alexander T., *Mills Building, San Francisco, Cal.*
Von Bayer, Hector, *U. S. B. F., Washington, D. C.*
Von Lengerke, J., *318 Broadway, New York City.*

Waddell, John, *Grand Rapids, Mich.*
Walker, Bryant, *Detroit, Mich.*
Wallich, Claudius, *U. S. B. F., Afognak, Alaska.*
Walters, Chas. A., *Oxford & Mervine Streets, Philadelphia, Pa.*
Ward, Prof. H. B., *Lincoln, Neb.*
Waterhouse, Rev. E. M., *Broadway and 71st Street, New York City.*
Webb, W. Seward, *44th Street and Vanderbilt Avenue, New York City.*
Webb, W. M., *State Oyster Commissioner, Morehead City, N. C.*
Wentworth, E. E., *U. S. B. F., Baker, Wash.*

Wheeler, Charles Stetson, *2413 Washington Street, San Francisco, Cal.*
Whipple, Hon. Jas. S., *Capitol, Albany, N. Y.*
Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*
White, R. Tyson, *320 Bridge Street, Brooklyn, N. Y.*
Whitaker, Hon. Andrew R., *Phoenixville, Pa.*
Wilbur, H. O., *235 Third Street, Philadelphia, Pa.*
Willard, Charles W., *Westerly, R. I.*
Wilson, C. H., *Glens Falls, N. Y.*
Winn, Dennis, *U. S. B. F., Washington, D. C.*
Winn, S., *Carolina, R. I.*
Wires, S. P., *Lester Park, Duluth, Minn.*
Wolf, Herman T., *489 The Bourse, Philadelphia, Pa.*
Wolters, Chas. A., *Oxford & Merrine Streets, Philadelphia, Pa.*
Wood, C. C., *Plymouth, Mass.*
Worth, S. G., *U. S. B. F., Beaufort, N. C.*

Young, Capt. John L., *Atlantic City, N. J.*

Zacharie, Col. F. C., *345 Corondelet Street, New Orleans, La.*
Zalsman, P. G., *Paris, Mich.*
Zweighaft, S., *Deer Park, Haines Falls, N. Y.*

HONORARY.

Adams, Mr. Fred J., *Grand Rapids, Mich.*
Besana, Mr. Guiseppe, *President Lombardy Fishery Society, Via Torino 51, Milan, Italy.*
Borodine, Nicholas, *Chief Specialist in Fish Culture, Department of Agriculture, St. Petersburg, Russia.*
Cortelyou, Hon. George B., *Washington, D. C.*
Denbigh, Lord, *Colonel of the Honorable Artillery Company, London, England.*
Fish Protective Association of Eastern Pennsylvania, *1020 Arch Street, Philadelphia, Pa.*
Fryer, Charles E., *Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, 3 Delahay St., London, England.*

Hamilton, Dr. J. Lawrence, *M. R. C. S., 30 Sussex Square, Brighton, England.*

Hock, Prof. P. P. C., *Scientific Fishery Adviser of the Dutch Government, The Hague, Holland.*

Hofer, Prof. Dr. Bruno, *Munich, Germany.*

Johnson, Mrs. Frank M., *Boston, Mass.*

Kishinouye, Dr. K., *Imperial Fisheries Bureau, Tokyo, Japan.*

Lake St. Clair Shooting and Fishing Club, *Detroit, Mich.*

Matsubara, Prof. S., *President Imperial Fisheries Institute, Tokyo, Japan.*

Metcalf, Victor H., *Secretary of the Department of Commerce and Labor, Washington, D. C.*

New York Association for the Protection of Fish and Game, *New York City.*

Peck, Hon. George W., *Milwaukee, Wis.*

Perrier, Prof. Edmond, *Director National Museum of Natural History, Paris, France.*

South Side Sportsmen's Club, *Oakdale, L. I., N. Y.*

Steindachner, Prof. Dr. Franz, *Royal Natural History Museum, Vienna, Austria.*

The Governors of the Several States.

The President of the United States.

Vinciguerra, Dr. Decio, *Director Royal Fish Cultural Station and Aquarium, Rome, Italy.*

Von Grimm, Dr. Oscar, *Inspector-General of Fisheries, St. Petersburg, Russia.*

Von Pirko, Mr. Franz, *President Austrian Fishery Society, Vienna, Austria.*

Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING.

Ayson, Lake F., *Wellington, New Zealand.*

Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*

Apostolides, Prof. Nicoly Chr., *Athens, Greece.*

Armistead, J. J., *Dumfries, Scotland.*

Birbeck, Edward, Esq., *M. P., London, England.*

Calderwood, W. L., Esq., *Inspector of Salmon Fisheries, Edinburgh, Scotland.*

Feilding, J. B., *Upper Downing, Holywell, North Wales.*
Giglioli, Prof. Enrico H., *Florence, Italy.*
Jaffe, S., *Osnabruck, Germany.*
Landmark, A., *Inspector of Norwegian Fresh Water Fisheries, Christiana, Norway.*
Marston, R. B., Esq., *Editor of the Fishing Gazette, London, England.*
Olsen, O. T., *Grimsby, England.*
Raveret-Wattel C., *Director of Agricultural Station at Nid-de-Verdier, 20 Rue des Acacias, Paris.*
Sars, Prof. G. O., *Christiania, Norway.*
Solsky, Baron N. de, *Director of the Imperial Agricultural Museum, St. Petersburg, Russia.*
Trybom, Dr. Filip, *Stockholm, Sweden.*

RECAPITULATION.

Active	382
Honorary	71
Corresponding	16
Total Membership	469

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this society. In case members do not pay their fees, which shall be two dollars per year, after the first year and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office

until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing Committees.
5. Committees appointed by the President.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussion of same.
   (Note—a. In the reading of papers preference shall be given to the members present.
   b. The President and two Secretaries are empowered to arrange the papers of the meetings of this Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting provided at least fifteen members are present at said meeting.

The thirty-seventh annual meeting of the American Fisheries Society will be held in September, 1908, at Washington, D. C., U. S. A.

639 A512

American Fisheries Society.

Thirty-sixth Annual Meeting

TO BE HELD AT ERIE, PA.,
TUESDAY, WEDNESDAY AND THURSDAY, JULY 23, 24, 25, 1907.

Announcement of Program.

DEAR SIR:—The American Fisheries Society will hold its annual meeting at Erie, Pa., July 23, 24 and 25, 1907. The meeting will be called to order at 12 o'clock noon, Tuesday, July 23. In addition to the regular business to be transacted and the election of officers a most interesting program of papers will be presented (see inside of this sheet) and the usual opportunity for discussing the same will be given.

The headquarters of the Society will be at the Reed House. Rates are from $2.50 to $4.00 per day, American plan. The Liebel House $2.00 to $3.00 a day; the Park View $2.00 to $2.50 per day. Reservation of rooms can be made in advance at any of these hotels.

Invitations have been extended to the Society to visit the Corry Hatchery; to visit Cambridge Springs; also a trip on the lake as the guests of the Commercial Fishermen.

Correspondence intended for the President or Secretary, too late to reach their regular post office address before July 18, should be mailed in care of the Reed House, Erie, Pa.

You are urged not only to be present at the meeting, but to bring with you as many candidates and names for membership as possible.

GEORGE F. PEABODY, *Secretary,*
Appleton, Wisconsin.

222931

Division of Fish

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED EIGHT

SMITHSO

ROBERT B. ROOSEVELT

President American Fisheries Society 1873-1882.
Born 1829. Died 1906.

By courtesy of Dr. Hugh M. Smith, Washington, D. C.

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-seventh Annual Meeting

SEPTEMBER 21-24, 1908,

At Washington, D. C.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS
1908

Officers for 1908-1909

President.....Tarleton H. Bean, Albany, N. Y.

Vice-President.....Seymour Bower, Detroit, Mich.

Recording Secretary.....George F. Peabody, Appleton, Wis.

Corresponding Secretary, Charles G. Atkins, East Orland, Me.

Treasurer.....C. W. Willard, Westerly, R. I.

EXECUTIVE COMMITTEE.

W. E. Meehan, *Chairman*, Albany, N. Y.

S. F. Fullerton, St. Paul, Minn.

Frank Miller, Put-in-Bay, Ohio.

G. W. Field, Boston, Mass.

W. P. Morton, Providence, R. I.

Geo. T. Mathewson, Enfield, Conn.

Jabe Alford, Madison, Wis.

AMERICAN FISHERIES SOCIETY

Organized December, 1870.

PRESIDENTS.

1.	William Clift	1870-1871
2.	William Clift	1871-1872
3.	William Clift	1872-1873
4.	Robert B. Roosevelt	1873-1874
5.	Robert B. Roosevelt	1874-1875
6.	Robert B. Roosevelt	1875-1876
7.	Robert B. Roosevelt	1876-1877
8.	Robert B. Roosevelt	1877-1878
9.	Robert B. Roosevelt	1878-1879
10.	Robert B. Roosevelt	1879-1880
11.	Robert B. Roosevelt	1880-1881
12.	Robert B. Roosevelt	1881-1882
13.	George Shepard Page	1882-1883
14.	James Benkard	1883-1884
15.	Theodore Lyman	1884-1885
16.	Marshall McDonald	1885-1886
17.	W. M. Hudson	1886-1887
18.	William L. May	1887-1888
19.	John H. Bissell	1888-1889
20.	Eugene G. Blackford	1889-1890
21.	Eugene G. Blackford	1890-1891
22.	James A. Henshall	1891-1892
23.	Herschel Whitaker	1892-1893
24.	Henry C. Ford	1893-1894
25.	William L. May	1894-1895
26.	L. D. Huntington	1895-1896
27.	Herschel Whitaker	1896-1897
28.	William L. May	1897-1898
29.	George F. Peabody	1898-1899
30.	John W. Titcomb	1899-1900
31.	F. B. Dickerson	1900-1901
32.	E. E. Bryant	1901-1902
33.	George M. Bowers	1902-1903
34.	Frank N. Clark	1903-1904
35.	Henry T. Root	1904-1905
36.	C. D. Joslyn	1905-1906
37.	E. A. Birge	1906-1907
38.	Hugh M. Smith	1907-1908
39.	Tarleton H. Bean	1908-1909

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PART I.

BUSINESS SESSIONS

Transactions of the American Fisheries Society

Monday, September 21, 1908.

Convention called to order at 10 A. M. by the President, Dr. Hugh M. Smith, of Washington, D. C., at the Arlington Hotel, Washington, D. C.

The following program was presented:

"Some Experiments on the Artificial Expression and Fertilization of Gold Fish." JERRY R. BERKHOUSE, Torresdale, Pa.

"Value of Carp as Furnishing Food for Black Bass." DR. S. P. BARTLETT, Quincy, Ill.

"Lobster Culture." PROF. A. D. MEAD, Providence, R. I.

"The Modern Hatching House." SAMUEL F. FULLERTON, St. Paul, Minn.

"The Muskalonge of the Ohio Basin." HON. TARLETON H. BEAN, Albany, N. Y.

"Description of San Marcos Station with Some of the Methods of Propagation in Use at that Station. JOHN L. LEARY, San Marcos, Tex.

"Some Reasons for Failure of Fish Protective Legislation and Some Suggestive Remedies." OREGON MILTON DENNIS, Baltimore, Md.

"Some Points in the Migration of Pacific Salmon as Shown by Its Parasites." PROF. HENRY B. WARD, Lincoln, Neb.

"Gases Dissolved in Waters of Wisconsin Lakes." DR. E. A. BIRGE, Madison, Wis.

"Experiments in Hatching Small-Mouth Black Bass." ROBERT RIPPEL, Woodruff, Wis. (Presented by Dr. E. A. Birge.)

"Some Peculiarities in Spawning Habits of Large-Mouth Black Bass." J. J. STRANAHAN, Bullochville, Ga.

(Question Box.)

The President then read his annual address.

President: We are honored today in having with us some of our esteemed honorary and corresponding members, among them

being Mr. Charles E. Fryer, Head Inspector of Fisheries of England; Dr. P. P. C. Hoek, Scientific Fishery Adviser of the Dutch Government; Dr. Decio Vinciguerra, Director of Royal Fish Cultural Station at Rome, and Dr. O. T. Olsen of Grimsby, England, who comes to the International Fisheries Congress as the representative of the Royal Geographical Society. We are exceedingly glad to see these gentlemen with us.

There are quite a large number of applications for membership in the society which have not yet been acted upon, and there may be other applications for membership that have not been reported. I suggest that all applications be presented to a committee and that will enable us to vote on the entire series at one time. The treasurer and secretary will be named as members of this committee, and they can receive any names during the session of the society.

We will now listen to the reports of officers, and first we will have the report of the secretary.

Secretary Peabody: The secretary's report has been printed and sent to every member. There is nothing to add to that report specially.

President: We will then receive the report of the treasurer.

The treasurer then presented his report as follows:

To the American Fisheries Society of the United States of America.

GENTLEMEN:—I herewith submit by Annual Report as Treasurer from July 23, 1907, to September 21, 1908:

RECEIPTS.

1907.			
July 23	Balance cash on hand	$131.32	
	Life membership fees	40.00	
	Yearly dues	616.00	
	Reports sold	2.00	
			$789.32

1907.	EXPENDITURES.		Voucher No.
July 31	J. W. Titcomb, postage, etc	$ 4.28	(1)
Aug. 19	H. T. Leasure, use of lantern	5.00	(2)
Sept. 28	500 stamped envelopes	10.72	(3)
Oct. 19	H. M. Smith, President, postage	2.22	(4)

Oct. 27—Post Pub. Co., etching and letterheads.	10.25	(5)	
Oct. 25—Goodwin & McDermot, stenographers. 1908.	194.40	(6)	
Jan. 7—G. F. Peabody, Secretary, reports and envelopes	307.45	(7)	
G. F. Peabody, Secretary, postage	37.04		
G. F. Peabody, Secretary, services	25.00		
July 20—International Fishery Congress award.	100.00	(8)	
July 25—500 stamped envelopes	10.72	(9)	
July 28—G. F. Peabody, Secretary, 500 circulars	4.44	(10)	
G. F. Peabody, Secretary, postage on reports (omitted in previous year)	34.87		
Sept. 1—Charles G. Atkins, Corresponding Secretary, postage, printing, etc	28.44	(11)	
Sept. 10—J. C. Hall Co., receipt books	6.30	(12)	
Sept. 16—G. F. Peabody, Secretary, postage, printing, etc	25.64	(13)	
G. F. Peabody, Secretary, stenographer's services	25.00		
	$831.77		
Balance due Treasurer			42.45
			$831.77

Respectfully submitted,

CHARLES W. WILLARD, Treasurer.

Motion was made by Mr. Root and seconded by Secretary Peabody that the report be referred to an auditing committee to be appointed by the president.

Motion unanimously carried.

President: I will name W. E. Meehan, W. H. Boardman and W. T. Thompson as members of the auditing committee on treasurer's report.

The report of standing committees is the next thing in order. Is the executive committee ready to make report?

Mr. Meehan: Gentlemen, I have the honor to herewith present my report in behalf of the executive committee. At the last meeting of the society two resolutions were adopted, having the same end in view. The first directed the executive committee to get into correspondence with the United States government, the Canadian government, and the governors of the states

bordering on the great lakes, requesting them to appoint delegates to an informal international conference for the purpose of suggesting uniform legislation regarding the fisheries of the great lakes. The second resolution directed the committee to enter into correspondence with the governors of states bordering on the great lakes to endeavor to induce them to assist in having the various legislatures cede to the federal government state control of the great lakes. In conformity with these resolutions, the committee approved a letter on each subject and I forwarded them. The Minister of Marine at Ottawa, the Governor General of Canada, and all the states responded affirmatively in regard to the appointment of delegates to the proposed informal international conference. Nearly all the governors responded favorably concerning federal control. The secretary of state of the national government was the only one corresponded with who declined to appoint a delegate, apparently misunderstanding the purport of the letter, because he gave as his reason for refusing that previous efforts to secure uniform legislation had been futile.

As chairman of the executive committee, I then made arrangements for a personal interview with the secretary of state, but an illness intervened. On my recovery I was officially notified that a treaty had been signed between Great Britain and the United States by which the two governments would take control of the great lakes, and I was informally informed that state action would not be necessary, that a commission representing the Canadian government and the United States government had been formed for the purpose of examining conditions on the great lakes and suggesting a bill to be introduced into congress and the Canadian parliament simultaneously with the ratification of the treaty to regulate the fisheries. Under the circumstances I did not pursue the matter any further with either the governors or the secretary of state at Washington.

Subsequently, in June of this year, I was wired by the International Fisheries Commission, referred to in the former paragraph, to meet them at Erie. I did so and at their request gave them the conditions which prevailed in Pennsylvania, or that part of Lake Erie under the jurisdiction of Pennsylvania. With me at the time was the commissioner from Ohio, Mr. Paul

North, and in company with the commission went as far as Ashtabula, O.

The committee takes pleasure, therefore, in reporting that the great object for which it adopted resolutions in 1907, namely, federal control of the great lakes seems to be on the point of accomplishment. Only the ratification of the treaty and the enactment of legislation remains as far as we are aware.

Very little other work fell to the lot of the committee during the year. Only the usual letters offering badges for stenographic work.

The report was then received and placed on file.

President: Will Mr. Atkins make a brief statement on behalf of the standing committee on foreign relations?

Mr. Charles G. Atkins, East Orland, Me: In view of the International Congress of Fisheries meeting here in Washington, D. C., and the abundant opportunity we shall have in that congress and the reports made of it to consider the subject of foreign fisheries and fish culture in all its bearings, it was thought best by your committee to omit for the present year the preparation and presentation of any formal report for publication, and your committee therefore beg you to excuse them until next year.

President: Mr. Atkins' statement will be received and noted.

The president will appoint as committee on nomination of officers for the ensuing year:

Hon. George M. Bowers, representing the United States at large.

Mr. William P. Morton, Rhode Island.

Mr. R. Tyson White, New York.

Mr. A. R. Whitaker, Pennsylvania.

Mr. James Nevin, Wisconsin.

The president will also appoint as members of the committee on time and place of next meeting:

Dr. James A. Henshall, Montana.

Mr. Henry T. Root, Rhode Island.

Dr. T. S. Palmer, Washington, D. C.

The president will now appoint the committee on behalf of

the society to represent it at the International Fisheries Congress. The chair has the pleasure in announcing this committee which he has endeavored to have composed of members who would not go to the Fisheries Congress in any other capacity:

Mr. Seymour Bower, Michigan;
Mr. James Cruickshank, New York;
Dr. James A. Henshall, Montana;
Mr. H. F. Hurlbut, Massachusetts;
Mr. Edwin A. Newman, District of Columbia.

Mr. John W. Titcomb, Washington, D. C.: May I inquire if any definite program is arranged for the day?

President: The arrangement of the program was necessarily deferred until the members arrived. We shall give preference to those who are present with reference to the reading of papers. I will appoint on that committee the following:

Mr. Barton A. Bean,
Mr. Ward T. Bower,
Mr. I. H. Dunlay,
Mr. J. Frank Ellis,
Mr. B. W. Evermann,
Mr. W. P. Hay,
Mr. H. P. Moore,
Mr. T. S. Palmer, and
Mr. Henry Talbott.

Mr. Titcomb: Will there be three sessions today?

President: There will be two sessions at least today.

Mr. Titcomb: I make inquiry for the reason that people are telephoning to me about the matter.

Dr. H. C. Bumpus, New York City: In view of there being present those who have come to Washington to attend two different meetings, namely, that of the American Fisheries Society and that of the Fourth International Fishery Congress, as president of the congress, I would say that our first meeting, at which Hon. George M. Bowers, United States Commissioner of Fish-

eries, will preside, will be held in the hall of the National Geographic Society, Sixteenth and M streets, N. W. Hon Oscar S. Straus, Secretary of Commerce and Labor, will deliver an address of welcome on behalf of the United States Government; Hon. Henry L. West, Commissioner of the District of Columbia, will welcome the members to the city of Washington; and Dr. Hugh M. Smith, President of the American Fisheries Society, will extend a greeting on behalf of the society. A response in the name of the foreign members will be made by Dr. P. P. C. Hoek, Scientific Fishery Adviser of the Dutch Government.

All members of the American Fisheries Society are invited to become members of the International Fishery Congress and to partake in the discussions. Application for membership may be made to Mr. Frank M. Clark or to Mr. Ward Bower. The program for the International Congress is one that extends through the week until Friday night and continues on Monday of next week in New York, on Tuesday in Narragansett Bay, Wednesday in Woods Hole, Thursday in Boston, and Friday and Saturday in Gloucester. The program both in Washington for this week and outside of Washington for next week is an exceedingly interesting one, and I think that the members of the American Fisheries Society will without exception identify themselves with this important gathering.

President: I would like to supplement Dr. Bumpus' remarks by saying that the foreign delegates to the International Fisheries Congress, and other members of the congress also will please assemble in the diplomatic room at the state department at 9:30 o'clock tomorrow. There they will be received by the Secretary of State, and will proceed thence to the meeting hall, where the opening meeting will be held at 10:30 o'clock instead of 10 o'clock. I may say that the programs in detail for the meetings of the International Congress will be distributed here and at the headquarters at the New Willard Hotel, this afternoon.

Mr. Titcomb: In view of the fact that there are some here who desire to join the American Fisheries Society, would it not be well to elect those who have already made application and have them registered?

President: The treasurer will please read the names of those who have been proposed for membership.

Treasurer: The following names have been presented for membership:

Adams, Oliver, *55 Glen Road, Toronto, Ont.*
Aller, H. D., *Beaufort, N. C.*
Anderson, August J., *Marquette, Mich.*

Baird, George W., (Admiral), *Washington, D. C.*
Barrows, A. L., *Cavite, Philippine Islands.*
Bliss, H. C., *(Alaska Packers' Association), Atlanta, Ga.*
Burgess, F. S., *Hammond Bldg., Detroit, Mich.*

Canty, J. C., *Galveston, Texas.*
Carleton, L. T., *Maine Fish and Game Com., Augusta, Me.*
Catte, Eugene, *Langdon, Kas.*
Crandall, A. J., *(Mgr. Ashaway Line & Twine Co.), Ashaway, R. I.*
Crary, F. C., *Hudson, Wis.*
Culler, C. F., *Wytheville, Va.*

Detwiler, John Y., *(Pres. Fla. Fish Com.), New Smyrna, Fla.*
Dewitt, R. E., *St. Joseph, Mo.*
Dorr, W. C., *(Alaska Packers' Association), San Francisco, Cal.*
Dornbos, H. J., *Grand Haven, Mich.*

Farr, E. D., *(U. and F. Comr.), Denver, Colo.*

Glennan, J. J., *(B. F.), Washington, D. C.*
Goodwin, H. D., *Milwaukee, Wis.*
Gorham, Wm. B., *(Fish Culturist), Erwin, Tenn.*

Hannah, Robert, *Fergus Falls, Minn.*
Heinrichs, Henry J., *(Keystone Fish Co.), Erie, Pa.*
Hafer, A. W., *Bellefonte, Pa.*
Hemingway, E. D., *123 Rochelle Ave., Wissabrickon, Philadelphia, Pa.*

Jaggard, E. A., (Judge), *St. Paul, Minn.*
Jordan, E. C., *(Northampton Co.), Cheriton, Va.*

Jordan, George C., *(Equitable Life Ins. Society), Washington, D. C.*

Kavanagh, A. J., *(B. F.), Leadville, Colo.*
Kellogg, Prof. James L., *(Williams College), Williamstown, Mass.*
Kilpatrick, Chas. M., *(Station F.), Minneapolis, Minn.*
Kincaid, W. S., *(State Supt.), Denver, Colo.*

Lay, Charles, *Sandusky, O.*
Libby, T. E., *Vinal Haven, Me.*
Light, R. M., *(Colo. Fish Com.), Denver, Colo.*

McAllister, H. C., *(Master Fish Warden), Portland, Ore.*
McDonald, Miss Rose, *(B. F.), Washington, D. C.*
Meekins, Theo. S., *Manteo, N. C.*
Miller, Frank M., *605 Maison Blanchet Bldg., New Orleans, La.*
Mowbray, Louis L., *Hamilton, Bermuda.*

Nesley, Chas. H., *(Dept. Fisheries), Harrisburg, Pa.*

Pratt, Joseph Hyde, Ph. D., *Chapel Hill, N. C.*
Prince, Hon. E. E., *(Dominion Com. of Fisheries), Ottawa, Canada.*

Saunders, J. P., *(Supt.), Deerwood, Minn.*
Scully, J. S., *(The Burlington), Washington, D. C.*
Shiras, Geo., *(32 Stonelaigh Court), Washington, D. C.*
Smith, Richard, *Waukegan, Ill.*
Speaks, John C., *(Chief Game Warden), Columbus, O.*
Stiles, Robert, *Sultan, Wash.*
Stone, J. W., *(State Fish Warden), Madison, Wis.*

Thomson, G. H., *(Fish Culturist), Estes Park, Colo.*

Wallace, John H., Jr., *Montgomery, Ala.*
Webb, W. M., *Morehead, N. D.*
Webster, H. A., *Oregon City, Ore.*
Wessel, Joseph A., *Crookston, Minn.*

CORRESPONDING MEMBERS.

Higginson, Edwardo, *(Consul for Peru), New York City.*
Poiteau, M. Charley, *Lommel, Belgium.*

LIFE MEMBER.

Dominy, Jeremiah M., *South Haven, L. I.*

HONORARY MEMBERS

Von Kadich, Dr. Heinrich, *Department of Forestry and Domain, Vienna, Austria.*

Kitahara, Dr. Tasaku, *Imperial Fisheries Bureau, Tokyo, Japan.*

Antipa, Prof. Dr. Gregoire, *Inspector General of Fisheries, Bucharest, Roumania.*

Nordquist, Dr. Oscar Fritiof, *Superintendent of Fisheries, Lund, Sweden.*

The committee on membership recommend and move the election of these applicants.

Motion seconded by Mr. Meehan.

Unanimously carried.

Motion made that the secretary cast the ballot of the society, electing the applicants to membership.

So done.

Mr. John L. Leary of San Marcos, Texas, then read a paper, "Description of San Marcos Station With Some of the Methods of Propogation In Use at That Station."

President: We will now listen to the report of the auditing committee.

Mr. W. E. Meehan: We have examined the report of the treasurer together with the vouchers and found the same correct and recommend the adoption of the report.

The auditing committee's report is signed by the full committee.

We think that the treasurer should be thanked for the manner in which he has conducted his office.

Motion made, seconded and unanimously carried, adopting the report.

President: I will appoint the following committee on resolutions:

W. E. Meehan,

S. W. Downing,

Samuel F. Fullerton,
Charles G. Atkins,
Seymour Bower.

Mr. Meehan: I suggest that any members who have resolutions hand them to any member of the committee so that we can pass on them at the earliest possible moment.

The secretary then read a paper by Chester K. Green, of Cape Vincent, N. Y., on the subject of "The Increase of White Fish and Lake Trout in Lake Ontario."

Mr. Frank N. Clark, Northville, Mich.: Mr. President, as you appointed me one of the committee to consult members of this society to see if they wished to unite with the International Congress, I have seen most of them. I have checked off from the list of attendance all those that I have seen. There are several that I have not seen, and if they will hand the names in we will be glad to have them unite. The idea of the president was to hand these names in to the International Congress as applicants for membership from the American Fisheries Society. We wish to make this list as complete, before morning, as possible.

The registered attendance at the meetings of the society is as follows:

Alford, J., *Madison, Wis.*
Atkins, Chas. G., *East Orland, Me.*
Avery, Carlos, *Hutchinson, Minn.*

Baird, Admiral Geo. W., *Washington, D. C.*
Baldwin, O. N., *Leadville, Colo.*
Bartlett, Dr. S. P. *Quincy, Ill.*
Bean, Barton A., *Washington, D. C.*
Bean, Dr. Tarleton, H., *Albany, N. Y.*
Berkhaus, J. R., *Torresdale, Philadelphia, Pa.*
Bickmore, Prof. G. S., *Washington, D. C.*
Birge, E. A., *Madison, Wis.*
Bliss, H. C., *Atlanta, Ga.*
Boardman, W. H., *Central Falls, R. I.*
Booth, D. C., *Spearfish, S. D.*
Bowers, Hon. George M., *Washington, D. C.*
Bower, Seymour, *Detroit, Mich.*

Bower, Ward T., *Washington, D. C.*
Brown, Hon. George M., *Detroit, Mich.*
Buck, W. O., *Grand Lake Stream, Me.*
Buller, A. G., *Union City, Pa.*
Buller, H. M., *Bellefonte, Pa.*
Buller, Wm., *Corry, Pa.*
Bumpus, Dr. H. C., *New York.*

Carter, E. N., *St. Johnsbury, Vt.*
Clark, Frank N., *Northville, Mich.*
Crampton, John M., *New Haven, Conn.*
Cogswell, Theo. M., *Washington, D. C.*
Coker, Dr. Robert E., *Johns Hopkins Univ., Baltimore, Md.*
Conway, R. J., *Belle Isle, Detroit, Mich.*

Dean, H. D., *Neosho, Mo.*
Dinsmore, A. H., *Birdsview, Wash.*
Downing, S. W., *Put-in-Bay, O.*

Ellis, J. Frank, *Washington, D. C.*
Evans, A. Kelly, *Toronto, Canada.*
Evans, Barton D., *Harrisburg, Pa.*
Evermann, Barton W., *(Bureau of Fisheries), Washington, D. C.*

Fryer, Chas. E., *(Inspector of Fisheries), England.*
Fullerton, S. F., *St. Paul, Minn.*

Geer, E. Hart, *Hadlyme, Conn.*
Gill, Dr. Theo., *Smithsonian Institute, Washington, D. C.*
Glenmare, J. J., *(Bureau of Fisheries), Ill.*
Goodwin, H. D., *Milwaukee, Wis.*
Green, Chester K., *Cape Vincent, N. Y.*

Haas, Wm. T., *Spruce Creek, Pa.*
Harron, L. G., *Washington, D. C.*
Henshall, Dr. J. A., *Bozeman, Mont.*
Hoek, Dr. P. P. C., *(Scientific Fishery Adviser), Holland.*
Hurlbut, W. F., *East Freetown, Mass.*

Jennings, G. E., *New York.*

Keesecker, A. G., *(Supt. B. of F.), Erwin, Tenn.*

Kitahara, T., *(Expert of Fisheries Dept. of Agriculture and Commerce), Tokyo, Japan.*

Lambson, G. H., *Baird, Cal.*
Lay, Charles, *Sandusky, O.*
Leary, John L., *San Marcos, Tex.*
Lydell, Dwight, *Mill Creek, Mich.*

Mathewson, Geo. T., *Thompsonville, Conn.*
Meehan, W. E., *(Supt. of Ohio Station), Put-in-Bay, O.*
Morton, Wm. P., *Providence, R. I.*

Nesley, Chas. H., *Harrisburg, Pa.*
Nevin, Jas., *Madison, Wis.*
Nordquist, Dr. Oscar, *Lund, Sweden.*

O'Malley, Henry, *Oregon City, Oregon.*
Olsen, O. T., *Grimsby, England.*

Palmer, Dr. T. S., *(Dept. of Agriculture), Washington, D. C.*
Peabody, Geo. F., *Appleton, Wis.*
Peoples, Hiram, *New Providence, Pa.*

Race, E. E., *Green Lake, Me.*
Rankin, Jas. F., *South Charleston, O.*
Roberts, A. D., *Woonsocket, R. I.*
Robinson, Robert K., *White Sulphur Springs, W. Va.*
Root, Henry T., *Providence, R. I.*

Safford, W. H., *Conneaut Lake, Pa.*
Seagle, George A., *Wytheville, Va.*
Sellers, M. G., *Philadelphia, Pa.*
Smith, Dr. Hugh M., *Washington, D. C.*
Sumner, F. B., *Woods Hole, Mass.*
Surber, Thad., *White Sulphur Springs, W. Va.*
Stapleton, M. F., *Mammoth Spring, Ark.*
Stone, J. W., *Madison, Wis.*

Thompson, W. T., *Leadville, Colo.*
Titcomb, J. W., *Washington, D. C.*

Vinciguerra, Dr. Decio, *(Royal Fish Cultural Station), Rome, Italy.*

Wallich, Claudius, *Afognak, Alaska.*
Ward, Dr. Henry B., *(Univ. of Neb.), Lincoln, Neb.*
Webster, B. C., *Bellefonte, Pa.*
White, R. Tyson, *Brooklyn, N. Y.*
Willard, C. W., *Westerly, R. I.*
Wilson, C. H., *Glens Falls, N. Y.*
Whitaker, Andrew R., *Phoenixville, Pa.*
Worth, F. G., *Beaufort, N. C.*

Adjourned until 2 P. M., same day and place.

Same place, Monday, September 21, 1908, 2 P. M.

Meeting called to order by the president.

Dr. S. P. Bartlett of Quincy, Ill., presented a paper on the subject of the "Value of Carp as Furnishing Food for Black Bass," which paper was read by Secretary Peabody, at the request of Dr. Bartlett. The paper was discussed.

President: We will now receive the report of the committee on nominations, which will be presented by the chairman, Mr. Seymour Bower.

Mr. Bower: The committee appointed to select officers for the American Fisheries Society for 1908 and 1909, beg leave to submit the following recommendations:

President—Dr. Tarleton H. Bean, Albany, N. Y.
Vice President—Seymour Bower, Detroit, Mich.
Recording Secretary—George F. Peabody, Appleton, Wis.
Corresponding Secretary—Charles G. Atkins, East Orland, Me.
Treasurer—C. W. Willard, Westerly, R. I.
Chairman Executive Committee—William E. Meehan, Harrisburg, Pa.

Members of Executive Committee:

S. F. Fullerton, St. Paul, Minn.
Frank Miller, Put-in-Bay, O.
G. W. Field, Boston, Mass.

W. P. Morton, Providence, R. I.
George T. Mathewson, Enfield, Conn.
Jabe Alford, Madison, Wis.

Motion made, seconded and unanimously carried adopting the report and electing the officers.

Prof. Henry B. Ward of Lincoln, Neb., then read a paper on the subject of "Some Points in the Migration of Pacific Salmon as Shown by Its Parasites," which paper was fully discussed.

President: The secretary will now read a communication from Mr. Joslyn, a former president of the society.

Detroit, Mich., Sept. 21st, 1908.

Dr. Hugh M. Smith,
President American Fisheries Society,
Washington, D. C.

Greatly disappointed, but I cannot be there; expected to until last week. I have no doubt that the meeting will be enjoyable and valuable to us all. C. D. JOSLYN.

Secretary: Most of the members are acquainted with Prof. Joslyn, and will appreciate his efforts to be here.

I will read the following resolution which has been presented by Dr. Smith:

Resolved by the American Fisheries Society in annual meeting assembled, That we have learned with pleasure of the conclusion of a treaty between the United States and Great Britain by which the fishery question affecting the operations of the United States fisheries on the coast of British North American provinces will be submitted to arbitration.

Resolved, That the conclusion of a convention between the United States and Great Britain by which the regulation of the fisheries of the contiguous waters of the United States and Canada will be assumed by the two federal government, marks a distinct epoch in the history of American fisheries, and we pledge our official and personal efforts to facilitate the work of the International Fisheries Commission appointed under this convention.

Mr. Fullerton: Should it not be referred to the committee on resolutions?

President: It was brought up at this time in order that anyone might discuss it if necessary. Does Dr. Evermann want to speak on that?

Dr. Evermann: If it is to be referred to a committee perhaps there will be opportunity for discussion hereafter.

President: There will be such opportunity and the resolution will be referred to the committee on resolutions.

The chair would like to call upon a highly esteemed corresponding member of the society, who comes to us in person at this meeting, and desires to offer a proposition for our consideration, Dr. O. T. Olsen of Grimsby, England. (Great applause.)

Dr. Olsen: Mr. President and gentlemen, I rise with pleasure at your call. You were good enough to have my proposition read last year, and it is a proposition for an International Fisheries Society to be formed with a view of consolidating results of progress made in the fisheries world. I think when we have such gatherings as these we often forget many important points. Sometimes they are not recorded, and at other times they are shelved. But by having a society formed which would be a permanent one, and which would gather up all information that is brought to bear upon the fishery world, then I think much good could be done.

The few points which I enumerate are these:

The natural history of fishes, their use as human food, their migration and habits. That is one thing that we ought to study in order to trace the fish. I am speaking now more particularly of salt water fish as we have very little to do with fresh water fish in England, not having many rivers where they cultivate them.

The second is the means of catching, preserving and transporting fish—also for salt water fish.

Oceanography, the physical condition of the sea, the tidal effects, and also artificial hatching of salt water fish.

The fishery laws, determining the nationality of the fishing vessels of the sea, etc.; their appliances and the qualifications of skippers and mates, as well as the crew; their examination showing competency, and other matters; and last, but not least, territorial limits which have been a bone of contention in England for some years now.

There is an international convention formed which sat at The Hague in 1883. This convention formulated a certain code of rules and laws, and we have police patrolling the fisheries of

the North Sea, from different nations, and these police have done exceedingly good work. If for nothing else, there is one thing for which they deserve praise, and that is stopping the sale of spirits to the fishermen in the North Sea, and now I am pleased to say that these boats have been actually exterminated, and the mission to deep sea fishermen has taken up the selling of tobacco at sea, for that used to be the loop-hole—they had to get tobacco, but instead of that they got spirits. Now the tobacco is supplied at a shilling a pound from mission boats.

Now this proposition for an international society was read here last year at your meeting, and at the same time I read it in Belgium at a fisheries congress there, and it was approved, and we were to have started it there. But a certain government official wanted to formulate a code of rules first and send them over to me for correction. He has failed thus far in doing so, but they have formulated another document, and I have a translation of it here, but that does not meet the point. It is not for any country or any one individual or committee to say where that document shall be kept; it is for the members to whom it belongs. Now when the society is formed, it is then time enough to find a locker to put the document in, but I would like to have this launched in the greatest country in the world, and especially the United States of America, where you have the largest inland fisheries in the world, and you are able and I believe willing to extend your knowledge to the different countries that require such information. At the same time I think that I dare say both on behalf of England and on behalf of other states of Europe, that they will be willing to reciprocate kindnesses by giving information relating to salt water fisheries which are not carried out to a great extent in America, except by lines. We have what we call the beam-trawl and also the auto-trawl, and those fisheries are very productive, and I think that the Canadians and also the people of the United States will be taking up trawling after ground fish.

My proposition is now, that a committee be appointed to start this society at this meeting. If anybody wishes to assist in the matter I should be highly gratified. Perhaps the president will say a word more about it. (Applause.)

President: I think we appreciate the importance of the matter that Dr. Olsen has brought up. I would suggest that he put his proposition in writing and that it be referred to the committee on resolutions for an expression of an opinion on behalf of the society.

Secretary: A matter that has been overlooked for a moment is a communication from Daniel B. Fearing of Newport, R. I. He wishes to propose as a life member Jeremiah M. Dominy, postmaster of South Haven, Long Island, and superintendent of the Suffolk Club, at the same place. Mr. Fearing has written me requesting that the American Fisheries Society be asked if any one has had any personal experience in stocking waters with striped bass, and something regarding the cost of doing this work. If there is anyone that could offer information on that point it would be perhaps, very valuable to the society as well as to Mr. Fearing, and I would present Mr. Dominy as a life member, for your vote.

Mr. Willard: The name of Mr. Dominy was presented in like manner last year and voted upon and he was elected a member.

President: Mr. Fearing is a member of this society whom very few of us have had the pleasure of meeting. He has the largest private library of fish and fishery literature in the United States, at his home in Newport, and is an enthusiastic member of this society, although he is prevented from attending its meetings. I would like to ask some of the gentlemen engaged in cultivation of striped bass whether they cannot answer Mr. Fearing's inquiry. The question is as to stocking new waters with striped bass.

This question was then taken up and discussed.

Mr. Titcomb: Now I should like to have the society consider again through its very efficient committee, who two or three years ago designated the sizes of fish by numbers, to take up that question and to designate more definitely those sizes. To illustrate what I mean, for those who were not present: you recall that the society decided that a fish from one to two inches in length should be called a number one fingerling; and from two

inches long up to three inches, a number two fingerling, and so on. Now you take a fish one inch long and compare it with a fish one and seven-eighths inches long, both are number one fingerlings, but there is too much discrepancy in the size. You can transport twice as many, I can safely say, of the one-inch fish, as you can carry of the fish one and seven-eighths inches in length. You take the two-inch fish as compared with the fish two and seven-eighths inches in length (I merely use those figures for illustration) and you will find the same discrepancy. It is difficult to make up a table. For instance you cannot say that you will carry a definite number of number one fingerling or number two fingerling to a regulation transportation can of water, because there is such a tremendous difference in the size. Here is a fish called a number three fingerling which is a trout three and seven-eighths inches in length, which I exhibit to you. Here is another three inches in length. One fish which I exhibit will weigh three times what this second fish will weigh, yet they are both number three fingerlings. You take the number one and there is more difference proportionately in weight between the number one which is an inch long and the number one which is one and seven-eighths inches in length. It seems to me we have got to have some intermediate numbering or half numbers to properly designate our fish in order to tell what we are distributing. You tell a man he is getting number three fingerlings and they may be three and seven-eighths inches long, but he expects a thousand number three, and you cannot carry of that size more than one hundred and twenty-five to a can, whereas of the fish just three inches long you can carry three hundred or even four hundred. I should like to have that committee take that question up and thresh it out and take for illustration these fish which I exhibit to you.

President: If there is no objection this question of renaming of fishes, such as are artificially cultivated, with reference to their size, will be referred to the same committee, with instructions to report at the next meeting.

Mr. Frank N. Clark, Northville, Mich.: I think I was one of that committee, but we were discharged as I understood it.

We made our report finally and that committee is not in existence.

Mr. Henry T. Root, Providence, R. I.: Mr. Clark was chairman and Mr. Seymour Bower was one of the other members.

President: The proper procedure would be to reappoint the committee or appoint another committee, whichever the society directs.

Mr. W. T. Thompson, Leadville, Colo.: I move that the members of that committee be authorized to take that matter up.

President: Is it the pleasure of the society that this same committee be reappointed with instructions to consider this matter at this session and make report before adjournment? Four of the five members are present and it would be possible for them to get together and consider this question.

Mr. Clark: Do I understand this committee is again appointed.

President: It will be if the society so directs.

It is moved and seconded that a committee, consisting as far as possible of the former members, be appointed.

Mr. Titcomb: I suggest that Dr. Bartlett be added to that committee in place of Mr. Whish, who is absent.

Motion seconded and unanimously carried.

President: The committee consists of Messrs. Frank N. Clark, W. E. Meehan, John D. Whish, S. P. Bartlett, and H. M. Smith.

Mr. Clark: May I just say a word on the subject?

President: Certainly.

Mr. Clark: This committee took two years to settle this question when it was before them formerly. Now you propose to have them report at another session of this meeting, and I understand you are going to try to get through today. After working upon this plan for several years it does not seem to be exactly satisfactory even though two years were spent in settling the question. Now you want it settled in a few hours, and I

most strenuously object. I object to acting on that committee in any manner like that and settling it. I do not think it could be done. If it is not right, very well, I am willing to serve on the committee as long as I may live, if you want me to, but I do not want to act upon the committee and settle the question in two hours, after working two years to fix upon a certain definite system.

Dr. Bartlett: It seems to me passing strange that a body of men such as we have here interested in that feature, who have had two years' experience on that line, cannot settle the matter in a very short time. I am interested in this matter. I telegraph to my superiors that I have made a shipment of so many number ones and so many number twos, but when I get up to the sixes and sevens the variation in rate is increasing all the time. The number that goes forward in cans does not tally with the number represented in my shipping card. It must be a matter of a good deal of inconvenience, and I think in three of four hours we could reach a conclusion. We might have intermediate numbers and arrive a little closer at the truth. We have had two years' experience to base our decision on.

Mr. Clark: We have had two years' experience and I am pretty well satisfied with the present plan. You may get up any plan—I don't care what it is—it will vary unless you get it into eighths. When bass will grow five-eighths of an inch in three days, what are you going to do? I think the system is pretty good as it is now, and if the committee attempt to do anything now I will argue along that line. I really think it is a mistake. Dr. Bartlett may be all fixed and satisfied in his mind, and Mr. Meehan may be (I don't think you have got the personnel of the committee as it was before, exactly) and they may know just what to do and say, but it seems to me it is too short a time to try to arrive at any satisfactory conclusion.

Mr. Titcomb: I rise to a point of order. I think the matter should be discussed in committee, not here.

Mr. Root: I don't think the chairman has the names of the committee just as it was before.

President: The president mentioned them from memory, and doubtless possibly made some mistake. I would be glad to be corrected.

Mr. Root: I do not think I was on that committee.

Mr. Clark: Do I understand the committee is supposed to act or report at this meeting?

President: The committee is without instructions.

Mr. Clark: Without instructions—thank you.

President: —As yet. (Laughter.)

If there is no further discussion the report will be made at the discretion of the committee, unless the society otherwise orders.

The chair will call upon the committee appointed to consider the time and place of next meeting.

Dr. J. A. Henshall, Bozeman, Mont.: Mr. President, the committee has entertained and considered a number of places proposed by different members, and have come to the conclusion unanimously to recommend that the society meet on the 12th of July, 1909, at the Mammoth Hot Springs Hotel, in the Yellowstone National Park.

Mr. Seymour Bower: The resolutions committee now have a resolution under consideration to fix the time of meeting of our annual meeting in September, instead of July, and I suggest that we decide upon a place of meeting at this time and not on the time, because we will undoubtedly bring in a report recommending that we meet in September instead of July, provided we find it does not conflict with the constitution and by-laws.

Dr. Henshall: I would say September would be too late for the Yellowstone National Park.

Mr. Clark: I would suggest that Mr. Titcomb be added to this committee and make such motion if it is in order.

President: He will be appointed on the committee if there is no objection.

There is no provision of the constitution or by-laws fixing

the time when the meetings of the society shall be held. It can be determined at each meeting before the subsequent meeting.

Mr. W. P. Thompson, Leadville, Colo.: I think there were particular reasons why the meeting for the coming year should be fixed at an early date, as that is the best time to see the work in the National Park. I hoped that Mr. Booth would have made some remarks along that line, but I would move that the report of the committee be adopted as to time and place, and then whatever date the committee on resolutions might fix would be for future meetings and not the next meeting.

Mr. Titcomb: I hope that matter will be allowed to rest a little while. I realize that we cannot see the fish cultural work in the park unless we go there as early as the 12th of July, but we have, some of us, other work that it is pretty hard to leave at that time, and I think we should give that a little more consideration, as suggested by Mr. Bower. I am heartily in favor of the park and I would like to have you see the trout spawning there. Suppose you let it go until this evening.

President: The report of the committee on time and place of meeting is still before you.

Mr. Titcomb: If we are going to have a session tonight I move to lay it on the table temporarily.

Motion seconded and unanimously carried.

President: The chair has been waiting for some statement from the chairman of this committee to the effect that the time selected had special reference to the absence of road agents from the park. (Laughter.)

We will proceed with the reading of papers, if the society so desires, and I have great pleasure in calling on Dr. Theodore Gill of the Smithsonian Institution, for remarks on the "Spawning of the Common Eel," a subject that has great popular and technical interest.

Dr. Gill then addressed the society on the subject of "The Life History of the Common Eel," and the address was fully discussed.

Mr. Clark: I wish to state that the committee will hold a

public hearing for all those who desire to be heard on the subject of the naming of fish of different size, and I desire the stenographer to be present to make a report of the hearing.

Mr. W. E. Meehan: I hope that the committee will allow a few minutes for the resolutions committee to finish up its work.

Dr. J. A. Henshall, Bozeman, Mont.: Most of the talk has been on the generation and propagation of fishes, but in the interest of the protection of fish, which I deem of equal importance, I desire to present the following resolution:

Whereas, In the irrigating canals already constructed by the United States Government in the western states there is no provision made for the preservation and protection of fish, either by screening the canals and ditches, or by the erection of fishways in the dams connected therewith; and

Whereas, The Government contemplates still more extensive systems of reclamation of arid lands, by the building of storage reservoirs in the mountain gulches, and by the construction of irrigating canals of great length and capacity that are to be supplied with water from flowing streams; therefore be it

Resolved, That a memorial be presented by this Society to the Congress, asking for such legislation as will provide fishways wherever practicable in all dams connected with the work of reclamation of arid lands; and also to provide for the installation of some effective device at the intake of all canals and ditches in connection with said work, in order to prevent fish from entering them.

Resolution referred to resolutions committee.

Dr. E. A. Birge, Madison, Wis.: I have two brief papers prepared by those working in connection with the Wisconsin Geological Survey and Fish Commissioners.

The first is on the subject of "The Tullibee as a Fish of Economic Importance".

Dr. Birge then read the paper which was discussed.

President: I will call on Prof. E. A. Birge of Madison for another paper which he will kindly present, on the subject of "Experiments in Rearing Small-Mouth Black Bass," by Robert Ripple, in charge of hatchery, Minoqua, Wis.

Prof. Birge: The paper was prepared by Robert Ripple, who

is in charge of the Minoqua Hatchery, and records experiments in artificial nests for small-mouth black bass.

Prof. Birge then read the paper which was discussed.

President: We will now listen to the report of the committee on resolutions by Mr. W. E. Meehan.

Mr. Meehan: The committee on resolutions present the following preliminary report:

Whereas, The International Fisheries Congress is to immediately begin its session, and during the period that the Fisheries Congress meets a meeting of the American Fisheries Society has been called; and

Whereas, The objects of this Congress are indentical with those of the Society,

Resolved, That, beginning on the morning of September 22, the American Fisheries Society identify itself with the International Fisheries Congress and attend its meetings, and recommend and urge that as many as possible become members. It is further

Resolved, That when the Society adjourns after its final session of today, it adjourns subject to the call of the President any time during the present week.

This resolution is signed by the committee.

Mr. Sam F. Fullerton, St. Paul, Minn.: I move that the resolution be adopted.

Motion seconded and unanimously carried.

A recess was here taken until 8 o'clock P. M., same day and place.

Same day, September 21, 1908, 8 o'clock P. M., same place.

Meeting called to order in the absence of the president, by Mr. W. E. Meehan, Harrisburg, Pa.

President (Mr. Meehan): Owing to the fact that my handwriting is poor and I am requested to proceed with the reading of the resolutions of the resolutions committee, myself.

The first resolution is as follows:

Resolved, That the Society announce meetings to be held in the month of September in the future instead of July.

This resolution the committee marks "not approved," the

constitution not providing any regular date, as it is, and the matter may therefore be left in the hands of the committee on location.

Mr. Frank N. Clark: I move that the report of the resolutions committee be adopted.

Motion seconded and unanimously carried.

President Mr. Meehan): The next resolution is, first in the form of a letter, which is as follows:

The Estes Park Improvement and Protective Association.
Estes Park, Colo., Sept. 16, 1908.

Mr. President and Members of the American Fisheries Society:

Gentlemen:—There is one matter that I should like very much to bring before your convention which seems to me of more than passing importance, "At least it is to the undersized fish." Our fish laws provide a "size limit" for fishing, and yet they say nothing about how to handle a fish in taking it off the hook in order to save its life. It does not seem to be generally known, and yet it is nevertheless a fact, that if a fish is grasped with a dry hand in removing it from the hook, that the dry hand will remove the slime from the back of the fish, and while it will swim off it will eventually die from fungus; while if the hand is moistened this condition will be avoided.

I have had this matter brought directly to my attention here in our fishing streams, and I printed cards with instructions upon it, and distributed them broadcast and it has been surprising to note the results, and how readily the fishermen adopt the information given and thereby carry out the meaning of the law.

The conditions that exist here in Colorado are no different than they are in other States where the law provides a size limit for fishing. I truly hope that the American Fisheries Society will take some action in the matter.

I enclose a "Resolution" that will bring the matter before you for discussion. Yours very truly,

G. H. THOMSON.

Whereas, It having been brought to the attention of the members of the American Fisheries Society, that while many of our States have passed laws establishing a size limit for fish that may be held for table use, they have said nothing whatever about how to handle a fish in taking it off a hook in order to save its life; therefore be it

Resolved, That we, the "American Fisheries Society," do most heartily endorse the card that is being circulated by G. H. Thomson, Superintendent of the Fish Hatchery at Estes Park, Colorado, in his "Plea for the Fish" and that we would urge upon the fish commis-

sioners of all the States, where there is a size limit on fish, to have this information made a portion of the fishing laws of their states.

This is not approved as a resolution but it is recommended that the various state commissions educate the people by every means in their power to follow the directions given in this resolution about wetting the hands.

Mr. Clark: Is this gentleman a member of the association?

Mr. Willard: Yes.

President (Mr. Meehan): This card has been sent broadcast throughout Colorado and sent to some commissioners. I received one. It is probably a good thing, but it seemed to the committee to be not proper to recommend to put in as a definition of the law or something to be done by the law, and as apt to befog the people.

Dr. Birge: I move that the recommendation of the committee be adopted.

Motion seconded and unanimously adopted.

President (Mr. Meehan): The committee recommend the adoption of the following resolution presented by Dr. Hugh M. Smith:

Resolved, By the American Fisheries Society in annual meeting assembled, that we have learned with pleasure of the conclusion of a treaty between the United States and Great Britain by which the fishery question affecting the operations of United States fishermen on the cost of the British North American provinces will be submitted to arbitration.

Resolved, That the conclusion of a convention between the United States and Great Britain, by which the regulations of the fisheries of the contiguous waters of the United States and Canada will be assumed by the two federal governments, marks a distinct epoch in the history of American fisheries; and we pledge our official and personal efforts to facilitate the work of the International Fishery Commission, appointed under this convention.

Motion made, seconded and unanimously carried adopting the resolution.

President Meehan: The committee on resolutions unanimously recommend the passage of the following:

Resolved, That the American Fisheries Society, in annual meeting at the seat of government of the United States, expresses its great satisfaction at the attitude of the President of the United States toward fish protection and preservation as recently exemplified in his formation of the National Conservation Commission.

Resolved, That we pledge our individual and collective support to the measures that may be found necessary for carrying out the President's views.

Resolved, That a copy of these resolutions be forwarded to the President.

Motion made, seconded and unanimously carried, adopting the report of the committee and its recommendation.

President Meehan: Dr. James A. Henshall of Montana has presented to the committee the following resolution:

Whereas, In the irrigating canals already constructed by the United States Government in the western states there is no provision made for the preservation and protection of fish, either by screening the canals and ditches, or by the erection of fishways in the dams connected therewith; and

Whereas, The Government contemplates a still more extensive system of reclamation of arid lands, by the building of storage reservoirs in the mountain gulches, and by the construction of irrigating canals of great length and capacity, that are to be supplied with water from flowing streams; therefore be it

Resolved, That a memorial be presented by this Society to the Congress, asking for such legislation as will provide for building practical fishways in all dams connected with the work of reclamation of arid lands; and also to provide for the installation of some effective device at the intake of all canals and ditches in connection with said work, in order to prevent fish from entering them.

President Meehan: The resolutions committee approved this resolution with the recommendation that Dr. Henshall, who drew it, draw the memorial and forward it to the chairman of the executive committee to have it properly endorsed and forwarded to the federal authorities.

Motion made and seconded that the recommendation and report of the resolutions committee be adopted.

Dr. Birge: It seems to me that resolution should be qualified. We are asked to memoralize congress that legislation should be enacted requiring fishways in all dams connected with the work of reclamation of arid lands. Many of those dams are

built on streams which are dry a good share of the year, and never had or will have any fish. I think the wording of the resolution might well be changed in that particular so as to indicate the style of dam in which we wish to have fishways.

President Meehan: How would it do to insert the words "suggested on the recommendation of the bureau?"

Dr. Birge: Yes, or on all dams across streams containing fish, or something of that sort.

President Meehan: Those words will be inserted "on all streams containing fish."

Mr. W. T. Thompson, of Leadville, Colo.: I just want to say that while that might apply in the beginning it won't carry the thing through, because in some of the best places that we have in the Rocky Mountains for taking fish spawn when the dam was built we found the stream above contained no fish. There is one reservoir that I think of in particular, where we have taken upwards of 4,000,000 eggs, and fifteen years before that date it was nothing but a mountain meadow. Now very few of these reclamation projects are contemplated in places where it would not be possible and feasible to have fish.

Dr. James A. Henshall, of Bozeman, Mont.: The resolution is only intended to apply where canals are taken out of flowing streams that already contain fish. It does not apply to reservoirs in mountain gulches. There is a dam soon to be built in Wyoming twenty-five feet higher than the Flatiron Building in New York, but that would not be covered by the resolution; it applies to flowing streams where canals, sometimes 200 or 300 miles in extent, are taken from a river, and that is where some device should be placed for keeping fish from entering the canals; and in dams that are not too high practical fishways should be installed. That is the meaning of the resolution. It does not affect those immense reservoirs built in mountain gulches where the water would be perhaps several hundred feet in depth, and where no fresh water fish could live.

Dr. Birge: I move the wording of that resolution be left to the committee on resolutions to revise if it deems it wise to do

so, before printing. I mean that the resolution be adopted in substance, and that the wording of it be referred back to the committee for revision if it deems necessary.

Motion seconded and unanimously carried.

President Meehan: The following resolution has been presented to the committee by Mr. Wilson:

Whereas, One of the chief objects of the American Fisheries Society is the treatment of all questions regarding fish, of a scientific and economic character, and

Whereas, The members of the American Fisheries Society now assembled in the city of Washington, D. C., in view of the rapidly decreasing supply of fresh water fishes in many states and provincial waters with its attendant hardships upon the poor, as shown by the great increase in the price of the same, as well as in the ever decreasing catch of the sportsman, also affecting the very life of a great industry, are of the opinion that the present general legislation regarding closed season and size limit does not furnish the maximum amount of protection, and

Whereas, Through inability to shorten open seasons, or to specially legislate for certain localities where spawning actually begins before and extends beyond the period designated as the closed season, certain sections are deprived of the protection necessary to keep up the natural supply of new life; therefore,

Resolved, That we urge the various states and provinces of North America to enact such legislation as shall under severe penalties prevent the capture or disturbance of fresh water fishes while on their spawning grounds for the purposes of reproduction, such legislation in no way preventing the taking of fish or spawn under the supervision of state, national or dominion authority. Further

Resolved, That copies of this resolution be furnished the fishery departments of the various states and provinces of the Dominion of Canada.

President Meehan: That is not approved. The committee feels the matter is one governed entirely by local conditions and should be considered by local legislatures.

Mr. Clark: I move the adoption of the committee's report. Motion seconded.

Mr. Wilson: As the father of this resolution I wish to state that this is my first appearance in the meetings of the American Fisheries Society. I wish also to state that it is not the first time that a resolution of mine has been rejected by the commit-

tee on resolutions. I am not a scientific man, although I hold a paper that might permit me to take up the work of a fish hatchery. I am interested in the protection of the food fish of North America, and have been identified with that work for ten or more years, having spent my time and my money in the effort to conserve the food fish of this continent. Why, may I ask, should this resolution fail of passage in an organization, grand in all its departments, one of whose chief aims is the protection of the fish of this country? This is not a strange thing I am asking of you, gentlemen. You set apart certain localities to make up for losses of fish in certain waters, do you not? Other countries do. The state of New York sets aside streams to conserve the fish therein and to assist in the preservation of new varieties of fish. For instance, the streams flowing into Lake George, nine miles from my home, were closed entirely when they were stocked with landlocked salmon. Every argument that has been made today has been in favor of my resolution. The president of this organization said that there had been a bill presented in congress asking for some ninety-seven hatcheries to be built in the United States. Is that an argument, gentlemen, that your fish hatcheries are doing all the work and doing it successfully? I think not. It is said that this is a local affair. Well, perhaps it is. It is local, I will admit, in the state of New York, where the St. Lawrence river is open to bass fishermen the 19th of June, although the bass does not complete its spawning until early in July, on that river. Now what are you doing with that fish? How many bass have you hatched this last year? We had one application from the Anglers' Association of the St. Lawrence river for over a million bass. They said it was a joke when we called their attention to the fact that they opened the season for bass too early on the St. Lawrence river. Is fishing on the St. Lawrence river a local question? I hardly think it is. Now I have been identified with an organization called the North American Fish and Game Protective Association, whose chief end is to harmonize the law between the United States and the Dominion of Canada. As an officer in that organization I have been in close touch with the bureau of fisheries in the provinces of the Dominion of Canada. I know something about their fisheries. I heard some of the best men in Canada, pro-

fessors in the Megill University, in convention in Montreal, ask that the clubs of the provinces of Quebec and New Brunswick be thrown open to the public. They were asked why they did not fish for salmon in the other rivers up there. They said there were no salmon there, they had all been taken out! Is my resolution in line with the protection sentiment? Now we have a lot of Americans who go into Canada in clubs. I am a club member myself. Before the close season commences in Canada there are hundreds of pounds of brook trout taken off the spawning beds in the lakes and streams of Canada. Perhaps the American Fisheries Society does not have anything to do with the Dominion of Canada; but let me tell you gentlemen, you cannot divorce the question of the food supply as between the Dominion of Canada and the United States. New York state alone eats more Canadian fish than Canadian people do. Why? Because they need the fish and Canada needs the money. It is not a harmful thing, I am sure, to ask protection where the law is not put on soon enough, and where it is not kept on long enough, so that it protects at neither end in certain localities.

I have been forced to realize here this afternoon that in Pennsylvania and in other states bordering on the great lakes everything is all right. As a citizen of New York state I want to say that we are in trouble, are willing to own it and ask you for help. Will you give it to us?

Mr. George M. Brown, of Detroit, Mich.: With us the close season begins the 1st of May and ends the 20th of June. That is the whole state where the bass are not off their spawning beds when the close season ends. I am in favor of the resolution for the protection of the fish. The reason we have not changed the law in Michigan is because the local fishermen have had more influence in the legislature than all the friends of game protection.

Mr. Atkins: There is an abundance of law already in that direction. This resolution proceeds on the ground that we need legislation to protect the fish. But there is an abundance of law in almost every state. Probably there are some points that could be amended, but I take it that in almost any state in the union it would be quite easy to get those amendments made if the matter were properly presented to the legislature. So it seems to

me that this resolution is entirely out of place, that there is no call for it whatever.

Mr. Clark: In moving the adoption of the committee's report, I had in mind the trend of what we have done here today in a way of requesting legislation in regard to federal power. I thought probably the committee had that more in mind when they failed to approve of this resolution than anything else, and that so far as inland matters of the different states and provinces were concerned, the committee thought that the states themselves would take care of and handle their local legislation. I was not on the committee on resolutions, but that is what I thought the committee on resolutions had in mind, and it is what came into my mind at once, and therefore I moved the adoption of the committee's report. Now anything that will tend to help local legislation in inland waters I think the American Fisheries Society should endorse. We may not all be of the same mind as to how it should be done. Of course, it is well known that I do not approve of many of the laws that are on the statute books of the different states of the United States and provinces of Canada today, and no doubt you will realize that when you hear a paper I have prepared for the International Congress.

Now, so far as the bass are concerned, the close season laws of the different states should be strict, as the bass are rigid bed guarders. The time that matter was before the legislature of the state of Michigan I was asked by the chairman of the joint committee of the two houses to appear before them and give my views, and I think very likely Mr. Bower and some of the other commission men were; and I did, and I told them I would not have a close season but I would have an open season, and that open season would be only such time as would give the rod and line a chance to catch the fish, and in Michigan I would have the season open from the 1st of July to the 1st of November, and all the balance of the time closed. That is what I believe in so far as the bass is concerned, and no doubt your New York state law should be on that same principle. In other words, make the time as low as possible. I believe in that, but I do not believe that this society should take the matter up in such a broad way, as the resolution of Mr. Wilson would. Mr. Clark I think has

sounded the very key note of the matter. I realize that the bass season in Minnesota opens too early—the 29th of May. If this resolution dealt entirely with international or interstate waters even, the committee would have supported it, but I think it would be foolish to adopt it in the way it now reads.

Mr. Wilson: May I say one more word? I have no intention of trying to stampede you gentlemen to do something that you think is not right, but I want to say to you right here that the American Fisheries Society is an organization of high standing in this country. It has been my privilege to be invited to every fisheries conference that has been held in the province of Quebec in the last ten years; and I state that the proceedings of the American Fisheries Society have been freely used in those conferences. They believe that the American Fisheries Society is composed of a large body of high grade men in every department. Now, that being the case, are you not making a mistake if you do not set these people right when you have the opportunity?

As a representative of the protection element in the state of New York, I say that Mr. Whipple, the present commissioner, and the most capable one the state ever had, has given us practically all the legislation we ever asked for, with the possible exception where he was satisfied that we could not get it, and one of those instances is this question of taking bass out of the St. Lawrence river before they have spawned. Why, in public hearings before the legislature, a former superintendent of public instruction in the state of New York, and president of the Anglers' Association of the St. Lawrence, fought the shortening of the bass season, and all the members of the Anglers' Association, as well as the railroad interests, fought it. They wanted to get on the St. Lawrence as soon as the ice was out and the bass had stuck his nose out of the mud—if he stays in the mud. So that thing went on year after year, when Canada was setting us an example of having a season six or seven days later. Now we have succeeded in shortening the season this year seven days, and placing it in harmony with the Canadian law. That is why our association was born—to harmonize law, and to fight for international control. Gentlemen, referring to the influence of the American Fisheries Society, I reiterate that you possess more in-

fluence than we. It took two years for us to get a public sentiment on international control, and my first resolution went where this resolution went, and I said, gentlemen, we will come back and when we come back we will take you all in, and we did. I wish I could take you all in here tonight, and have you give moral support to this resolution which does not apply to any state in the union in particular, which does not ruffle a hair on any man's head, unless he is anxious to have it ruffled, and this is strictly in line with the protective system which we are all anxious to advance and for which the society stands; and I trust that the resolution will be passed unanimously.

Dr. Birge: It seems to me that this discussion is on a matter where all of us are agreed in principle, and where we differ as to the means of securing the end. There is no one here who does not believe in protecting fish, and this association is doing all it can to secure good legislation on the part of states and provinces, as far as we have influence with them. There is no difference of opinion among us here on the question of principle; the difference of opinion that has arisen here, is with regard to the specific things that are recommended in this resolution. While I am in full sympathy with the aims of the recommendation, there are several things in it for which I should not vote. I believe with Mr. Clark that the best method of protecting bass is not through special legislation, assigning a certain close season here and another there, but legislation along the line of a limited open season; and I am not ready to recommend the adoption of the opposite principle, because I do not believe it will work. Take a state like Wisconsin, extending over a long distance from north to south, with a great difference in the spawning season between the lakes in the northern and southern part of the state. If our legislature should legislate along the lines of this resolution it would make a certain open season for Vilas county, and another for Dane county. Now I do not believe that legislation of that special kind, lengthening the season and shortening it in another place, is going to stand. As a matter of fact, when that legislation is attempted with us in Wisconsin and attempted in good faith on all sides, each legislature sees the fish laws changed and modified as this man and that man wants, until no one in the state of Wisconsin (unless he is a Philadelphia lawyer)

knows what the laws as to fish and game are in the state. I ask you if that sort of tinkering of laws has not produced very much the same effect in other states.

Again, I think that this matter of imposing severe penalties is a mistake. I do not believe that by increasing the penalties provided in the laws of various states, the protection of fish is going to be advanced; I think it is going to be injured; I think you will find that where severe penalties are laid down by such laws, the result is that the law is not enforced, and that the severity of the penalty tends to make the law ineffective, because officers of the law feel that the penalty is not warranted by the crime, and shut their eyes to the offense. What we want is organization for the enforcement of moderate penalties so that they will be enforced with reasonable efficiency and with reasonable certainty.

While, therefore, I agree entirely and heartily with the spirit of this resolution I do not agree with its recommendation. I concur with the committee in that matter and I therefore move, since we are all agreed on the question of principle, that the resolution be referred back to the committee, to draw such a statement of the opinion of this society with regard to this resolution as seems wise and present it later.

Mr. Seymour Bower: As one of the members on the committee on resolutions and as one who opposed the adoption of the resolution under consideration, I want to say that the main reason why I did so is that this resolution is so broad and general that you can enact almost anything under it and claim that it has the backing of the American Fisheries Society.

Now if this gentleman (Mr. Wilson) has any specific proposition and will bring evidence to us that the sort of protection he recommends is needed in his locality, I will vote for it heartily, and I think every member on the committee will; but we do not want to be saddled with this resolution. This expression, "Protection of Fish," is a very deceptive phrase anyway. What one man thinks is protection another man does not. We disagree and we do not want to be called upon to father a general resolution that does not mean anything much in one way and may man almost anything in another.

Now, as I say, if this gentleman will bring in a specific

proposition looking toward the protection of fish we will support it.

Mr. Wilson: I offered to amend my resolution before the committee this noon, and asked them for suggestions on which I could base an amendment.

Mr. Seymour Bower: The resolution as introduced makes no provision whatever for allowing fish to be caught for the purpose of propagation, but absolutely prohibits the propagation of fish in commercial waters, and we suggested that that exception be made, and I notice that it is taken care of.

Mr. Meehan: The preamble was of such a character that the committee could not support it. The broad assertion was made in the original resolution that there is a rapidly decreasing supply of fresh water fishes; that was not a matter that the committee could subscribe to, and it so stated and the framer of the resolution subsequently brought in an amendment which was inserted, restricting the statement to "many of the states." At first there was a sweeping general statement that the fish were decreasing in all the streams of the country, and the other members of the committee have stated the matter just as I understand was the thought of the committee, and we felt that if we could not present the resolution with our approval in the form in which it was, we could not doctor it. The question was, could it be changed to meet with the general approval of the committee without framing something entirely different. If there was something specific, as Dr. Birge put it, presented, I have no doubt the committee would be glad to do something with it.

Mr. S. F. Fullerton, St. Paul, Minn.: As a member of that committee I should heartily endorse a resolution along the lines suggested. I know the gentleman's heart is all right, and that he wants to be right.

Mr. M. G. Sellers, Philadelphia, Pa.: Speaking for the state of Pennsylvania, I want to say that through the legislative committee of the Pennsylvania Fish Protective Association I was largely instrumental in securing the passage of a law making the open season for taking bass begin on the 15th of June, instead of the 30th of May. This was accomplished only after a great

many years of labor, and was due to a spirit similar to that which is expressed in the resolution under consideration. But as a born angler I am afraid my friend who spoke before me (Mr. Wilson) fails to place a proper share of blame on the sporting ranks for lack of results in an assertion so sweeping in character as to declare waters depleted of fish life.

When it comes to the bass question, unaided by artificial propagation, what is a sportsman's share, who does or should determine it? I believe from my own experience in the state of Pennsylvania where for very many years I have been active in securing proper legislation regarding fish, that we ought to leave questions of this kind to the different states. As I see it from the fish protectionist's view point, if they suffer from poor laws in New York state or in any other state, why is it not up to the anglers of the particular state to correct the laws? Why not organize a good central organization in all states to combine all the local or county organizations, and back up what is really the ideal of the sportsman, both for the close season and the numbers to be taken?

As a sportsman I want to say to you I cannot find any national standard to determine what is a sportsman's share. Nobody seems to know and nobody seems to set it. I wish I may see the day when the preliminary labors that we undertook in New York City last November will bring about an Anglers' Association of the United States. There is the place where I think a very important part of this question should have its greatest force and argument in co-operation with the work of this society.

Nowadays everybody goes fishing. You know as well as I do how the angling ranks of the great United States by states as a whole are heavily recruited each year. They pose as sportsmen, but do you really believe they all are? I cannot see it, so long as the idea of quantity is so generally accepted as the standard of skill. What we ought to labor for is to create higher ideals of sportsmanship in taking out of the waters what largely interests this society in placing therein, not to mention greater purity of the waters, but I hope this can be accomplished in the proposed new organization for which the preliminary meeting was held in New York City; and I trust that the time may come

when we can thus improve the sporting ranks to the end that we will get along more smoothly in connection with the fish cultural work of this society, and thereby relieve the various fish commissions of much unjust criticism of their work, and possibly increase their appropriations for scientific field work to more correctly determine as matters of fact whether or not waters are fished out.

Mr. Titcomb: I cannot help getting up to second the suggestion. I concur with Dr. Birge in his remarks, and I am in favor of the principle of Mr. Wilson's resolution, and if the committee could get that resolution into shape I would like to see it done. I am also a charter member of the North American Fish and Game Protection Association, and I know any resolution that this organization passes will have some influence there, where Mr. Alvord suggests that we have these local organizations to protect the fish where they ought to be protected, without inspiring a lot of cranks to introduce new legislation, and we all know that every legislator has to face fifteen, twenty or thirty times as many bills as ought to come up. If we can only get something that would do good and not do harm I would like to endorse it and help it through.

President: You have the motion of Dr. Birge that the resolution be referred back to the resolutions committee in order that it, in connection with the author of the original resolution, draft something in accordance with the views of the society that can be properly supported.

Motion unanimously carried.

Mr. Titcomb: When I moved that the matter of the time of holding the next meeting be laid on the table I did not think it would be well to hold a meeting at that time every year, and I think so still; but in view of all the arguments in connection with the location, and the fact that we are operating hatcheries at that time and fish will be seen on the spawning beds, and fish cultural operations inspected, I now move the adoption of the resolution.

President: I think it would be proper first to move to take the resolution from the table.

Motion made, seconded and unanimously carried, taking the resolution from the table.

Mr. Titcomb: I now move its adoption, that is, that the report of the committee on time and place be adopted.

Moved and seconded and unanimously carried, and report of committee unanimously adopted.

Mr. Clark: Are you ready to hear the report of the committee on size of fish?

President: Yes.

Mr. Clark: I can state that I weakened when we had our committee meeting on the size of fish and concluded that perhaps it would be better after hearing the discussion of the committee and members invited, and after talking the matter over very thoroughly, to make some change, and I will read the conclusion of the committee.

The committee report that the regulations regarding size of the fish remain the same, excepting that there be a subdivision of the numbered fingerling class to be designated by the letter A, to-wit:

Fingerlings number 1, one inch and less than one and one-half inch.

Fingerlings number 1 A, one and one-half inch and less than two inches.

Number 2, two inches to two and a half inches.

Number 2 A, two and a half inches to three inches, etc.

This was signed by the entire committee and I move its adoption.

Motion seconded, unanimously carried and so ordered.

Mr. S. F. Fullerton, of St. Paul, Minn., then read a paper on the subject of "The Modern Hatching House," which was discussed.

Mr. Jerry R. Berkhaus, superintendent of the Pennsylvania State Hatchery, Torresdale, Philadelphia, then read a paper on the subject of "Some Experiments in the Artificial Expression and Fertilization of Gold Fish."

President: The question now arises whether we shall go on

reading further papers. Possibly we might have a paper early in the morning.

Mr. Clark: I suggest that we adjourn, subject to the call of the president. We must get away from here at 9:30 o'clock, and I should think it would be better to adjourn subject to call, and if we find it impossible to get a large attendance, a few at least could meet and decide what to do with the papers.

President: They will be printed. We will get them in the proceedings. I think some definite action can be taken in regard to the disposition of the papers still unread. It is all very well to assume that they will be published in the annual report, but unless the authority is given they might not be published, and they all seem to be papers of value.

Mr. B. D. Evans, of Harrisburg, Pa.: A resolution was passed this afternoon that we should adjourn subject to call.

Mr. Clark: I suggest that we call for any unread papers on the program.

(The president then called the list of writers of papers on the program, still unread, but received no response.)

Mr. Titcomb: In view of the fact that the authors are not present I move that we consider that these papers have been read by title only, and that they be published in the transactions of the society if the committee consider them worthy.

Motion seconded.

President: It has been moved and seconded that the papers referred to be considered as read by title, and published in the annual report, provided the committee so decide.

This motion is seconded.

Mr. Fullerton: I hope that motion will not be passed, because we certainly will have time to hear some of these papers, and I know every member here wants to hear them—especially on the muskalonge question, and on the black bass.

President: And the lobster—if we could hear these papers and have a discussion of them it would be of benefit to every person here.

Mr. Clark: I move an amendment to the motion, that the matter be left open, and if time is not given us to have the papers read that they be published as stated.

Mr. Titcomb: I will withdraw my motion.

Mr. Clark's motion was then seconded and unanimously carried.

Meeting adjourned subject to the call of the president, pursuant to the resolution of this afternoon.

Same place, Wednesday, September 23, 1908, 7:30 P. M.

Meeting called to order by Mr. Meehan in chair.

President Meehan: Is there any unfinished business besides the report of the committee on resolutions?

The following resolution was presented by the committee on resolutions:

Whereas, One of the chief objects of the American Fisheries Society is the treatment of all questions regarding fish, of a scientific and economic character, and

Whereas, The members of the American Fisheries Society now assembled in the city of Washington, D. C., in view of the efforts being put forth by state, national and dominion departments of fisheries, in the artificial propagation and planting of various kinds of fresh water fishes, and maintaining the same for the public good, are of the opinion that the various states and provinces should supplement this great work by giving additional protection to all nest building fishes during the breeding season; therefore,

Resolved, That we urge the various states and provinces of North America to enact such legislation as shall prevent the capture or disturbance of nest breeding fishes, while spawning, and guarding the nests and fry. Further

Resolved, That copies of this resolution be furnished the Fisheries Departments of the various states of the American Union and provinces of the Dominion of Canada.

This has the approval of the entire committee.

Mr. Fullerton: I move that the report be adopted.

Motion seconded and unanimously carried.

President Meehan: If there is no other business it will be

my pleasant duty to appoint a committee of three to escort the newly elected president, Dr. Tarleton H. Bean, to the chair. There being no objection, I will appoint Mr. Frank N. Clark, Dr. J. A. Henshall and Mr. S. F. Fullerton as a committee to escort the newly elected president to the chair.

(The committee then escorted Dr. Bean to the rostrum amid great applause.)

(Dr. Bean took the chair.)

Dr. Bean (In chair.): Fellow members of the American Fisheries Society, I have very little to say to you except to convey my high appreciation of the honor which you have done me in electing me president of the society, and I promise that I will do whatever lies in my power to advance the interest of our cause. I hope that our future will be brighter and brighter from year to year, that our progress will be more rapid from now on than it has ever been before, and in order to accomplish this end I will work with you, and I am quite sure that I will have your most hearty co-operation. I thank you. (Great applause.)

President (Mr. Meehan, in chair.): The same committee will escort the newly elected vice president to the platform.

(This was done.)

Mr. Clark: We take pleasure in introducing the new vice president, Mr. Seymour Bower. (Great applause.)

Mr. Seymour Bower: I did not expect anything of this sort or I might have framed up something to say. I can only say that I thank each and every one of you heartily and sincerely for the high honor that you have conferred upon me, and that I will endeavor to do everything in my power to assist the president in making the next meeting a grand success; and I do not want to make any more promises; I prefer to wait until next year and let you judge whether I have delivered the goods or not. I thank you very heartily. (Great applause.)

President Bean: What business have we before us?

Mr. Clark: It seems to me that the members must understand where we meet next year and the time, Yellowstone Park, the 12th of July, and that our officers and executive committee

must make the proper arrangements. They are not going, as I understand, into a town, but they are going into the Yellowstone Park. Just where we will have our meetings must be arranged for, and to me it seems as though this should be done early, and some circular, or something of that kind, should be sent out early to the members so that they may make their plans accordingly. As the Yukon Exposition is held next year, they may wish to arrange in connection with that, to take in the American meeting going or coming, and therefore, it seems to me it would be a good plan for the officers and committee to make their arrangements early as to where they will meet in the Yellowstone Park, and then send a circular early in the season, February or March, that the members may have plenty of time to make their arrangements.

Mr. Fullerton: There are two routes in the Yellowstone Park, and I do not doubt but that every member that goes there will want to go through the Yellowstone Park, as well as to attend the meeting there. I suppose Dr. Henshall will tell us something about that. But there is the regular stage route and there is the Wiley route, and I think the committee ought to take that into consideration and find out what the difference in cost is between the two routes, and if the Mammoth Hotel cannot take care of us we must meet somewhere else.

Dr. Henshall: As a member of the committee on time and place of meeting, I will say that the resolution states that the meeting shall be held at the Mammoth Hot Springs Hotel. That is the only suitable place, and it is only five miles from Gardner, the end of the railroad. The Wylie Company is now under the auspices of the Transportation Company.

Mr. Fullerton: They are all combined.

Dr. Henshall: Yes. They still have the permanent camps, the same as Wylie had them, and the Transportation Company has the hotels, so the only place where we could hold the meeting would be the Mammoth Hot Springs Hotel, and there is no doubt but that arrangements can be made to meet there.

Mr. Fullerton: I might say further that the National Game Wardens' Association went through the park, and I think Dr.

Henshall went through with us, and conveyances were placed at our disposal free of charge and all it cost was the hotel accommodations, and I think that that same arrangement could be made with the superintendent of the park. I think with our president's influence that it could be done, and I am satisfied if the right and proper people are appealed to that we can get the transportation through the park free of charge.

Dr. Henshall: Major Pitcher is not the superintendent now, but General Young is there, and I have no doubt that arrangements can be made for government transportation through the park.

Mr. Root: I think it would be well to have Dr. Henshall help the executive committee out in this matter.

Dr. Henshall: I would be perfectly willing to assist the executive committee.

Mr. Meehan: I had intended to place the matter in the hands of Dr. Henshall with the consent of the rest of the executive committee.

Mr. Titcomb: I suggest you add to that committee Mr. Booth, who will be in the park at that time, and will be doing work for the Bureau of Fisheries there. There are two or three methods of getting through the park, of course, any part of the body can go one way and another part another; part can have hotel accommodations and part can camp if they wish; and I think Mr. Booth would be a very good assistant to the doctor, because he is right there on the ground.

Dr. Henshall: That is a very good suggestion.

President: I understood that the arrangements for the meeting next year are in the hands of the executive committee, and that the executive committee has delegated its authority to Dr. Henshall, and there is a suggestion that Mr. Booth also act with Dr. Henshall. I think a motion to this effect would be in order, and I would be glad to entertain such motion.

Mr. Meehan: Perhaps this motion had better come from the chairman of the executive committee. I move you that the ar-

rangements for the meeting at Yellowstone Park be placed in the hands of Dr. Henshall with the assistance of Mr. Booth, of Spearfish, North Dakota.

Secretary Peabody: As I understand from Dr. Henshall and others, there is one hotel there only, and practically we can only deal with one corporation. Now it might be possible that if we decided definitely on going there, absolutely and arbitrarily, that we could not make quite as favorable terms as we could if it was left in some such form as this: That the executive committee might make this arrangement if satisfactory, to go to the Yellowstone Park; if not they could decide upon some other point. We might be held up I don't know as there is any possibility of that sort of thing; I don't know anything about the park; but it is in the nature of things, that if we definitely decide on going to one hotel, we will not get the best terms.

Dr. Henshall: I will explain that there are four or five hotels, but all under the same management; the Mammoth Hot Springs is the first hotel you come to after entering the park, and is the usual place of meeting of all conventions that go to the park; after you have concluded your deliberations you can make your tour around the park. The rates are the same at all hotels, but the Mammoth Hot Springs is the most suitable place for holding the meeting, because it is only five miles from the end of the railroad.

Secretary: I understand that, but it is only one corporation—the whole thing.

Dr. Henshall: Yes.

Secretary Peabody: It is all the same thing—they charge any price they please; is there any fixed price, or have you any terms from them?

Dr. Henshall: The usual price has been $4 a day, and they made a reduction at the time that Mr. Fullerton speaks of, to the members of the Northwestern State Game Wardens and Commissioners' Association, to $3 a day, and they will probably do the same thing in this case.

Mr. Titcomb: I think Mr. Peabody has the right idea. I

think the executive committee should have control of arrangements, and that Dr. Henshall and Mr. Booth should make their report to the committee, and then have the committee send out circulars in the regular way. It is not necessary that we hold our meeting at the Mammoth Hot Springs Hotel more than one day anyway. We can go into the woods, and we can camp out if we wish. They will camp your whole party right on a brook and you can have your meeting outdoors and go out in the evening and catch some fish for supper. (Applause.)

Mr. Meehan: I will accept that as an amendment.
Seconded.

President: The motion is that the executive committee take charge of the arrangements, through Dr. Henshall and Mr. Booth, who are to report to the committee.

Dr. Henshall: My suggestion was that I would assist the executive committee. The executive committee has full charge, of course, but I will assist them in any way possible, and so will Mr. Booth.

President: Then the motion stands that the executive committee take charge of the arrangements for next year, and that they will be assisted by Dr. Henshall and Mr. Booth.

Mr. Fullerton: You have added to that committee Mr. Booth, a splendid selection, and I would like to add another, and that is Mr. Scott of Montana, a delegate to this convention. He did not get here though. He is president of the National Game Wardens' Association and takes a great deal of interest in this work, and stands well with the park authorities, as Dr. Henshall knows. I refer to Mr. W. F. Scott—he is right there on the ground.

Mr. Meehan: That is acceptable.
Seconded and motion as thus amended unanimously carried.

Mr. Wilson: I rise to move the reconsideration of the resolution presented by the committee on resolutions regarding protection of fish during the spawning season.

Mr. Meehan: I rise to a point of order. Did the gentleman vote for the adoption of the resolution?

Mr. Wilson: If I had not done so I would not ask for a reconsideration.

Is there a gentleman here who will second my motion so that this matter can be brought up?

Motion seconded.

President: I understood when we came together we were to adjourn at 7:30 o'clock. What do you wish to do?

Mr. Wilson: Am I in order?

Mr. Meehan: The motion to reconsider is not debatable.

Mr. Wilson: I rise to a question of personal privilege.

President: What is the question?

Mr. Wilson: The question is this: That I did not understand the reading of this resolution by the chairman of the committee on resolutions. The spirit of this resolution, Mr. President, has been removed entirely from the resolution. Am I free to discuss the resolution?

President: The chair is in doubt as to the proper proceeding in a matter of this kind.

Mr. Titcomb: I move that the gentleman be allowed to explain his trouble. There must be some misunderstanding about the matter.

President: Very well.

Mr. Wilson: Mr. President and gentlemen of the American Fisheries Society: I hold in my hand three resolutions—one, the original resolution presented by me on the subject of "Protection of Fish During the Spawning Season," and turned over to the committee on resolutions. That resolution was rejected, and afterward a motion was made that the resolution be changed in some respects, and then presented to the resolutions committee. In that committee it was suggested that the drafter of the resolution eliminate the so-called objectionable features of the same, and the chairman of the committee appointed Dr. Birge to confer with me regarding it, with the implied, if not expressed, understanding that what Dr. Birge and myself agreed regarding

the resolution would be satisfactory to the resolutions committee. Mr. President, with your permission, I wish to read the result of Dr. Birge's and my efforts in the production of a resolution that should suit the resolutions committee, which is as follows:

Whereas, One of the chief objects of the American Fisheries Society is the treatment of all questions regarding fish of a scientific and economic character, and

Whereas, The members of the American Fisheries Society now assembled in the city of Washington, D. C., in view of the efforts being put forth by state, national and dominion departments of fisheries in the artificial propagation and planting of various kinds of fresh water fishes, and maintaining the same for the public good, are of the opinion that the various states and provinces should supplement this great work by giving additional protection to all such fish during the spawning season. Therefore

Resolved, That we urge the various states and provinces of North American to enact such legislation as shall prevent the capture or disturbance of fresh water fish while on the spawning beds for the purposes of reproduction, such legislation in no way preventing the taking of fish or spawn under the supervision of state, national or dominion authority. Further

Resolved, That copies of this resolution be furnished the Fisheries Departments of the various states of the American Union and provinces of the Dominion of Canada.

Mr. President, I understand that the serious objection to my resolution is because it does not allow a given state having forty-five miles of shore line on a lake 414 miles long, the right to take fish from the spawning grounds during the proposed close season.

I stand here, gentlemen, in favor of protection of every valuable fresh water fish that swims, from the time it reaches the spawning bed for the purposes of reproduction until it has performed its function and retired decently and in order.

Furthermore, gentlemen, the best years of my life have been spent in seeking to formulate fishery regulations between the Dominion of Canada and the United States, so that there should be a maximum amount of protection to the food fish for the common people of both countries. I stand on that platform tonight, and if I go down to the disgrace of the American Fisheries Society.

A year or two ago the secretary of the New York Fish and Game Commission, with which your honored president is identified, asked me to take up the subject of the protection of the

whitefish, that they might not be entirely wiped out of the great lakes that border upon the state of New York. I am a busy man, and burned the candle at both ends to familiarize myself as a civilian of the state of New York, with this matter, that I might go before the authorities of the Dominion of Canada, the Province of Ontario, and my own state, which I did, and secured at the last session of the legislature a bill in harmony with the laws of every other state bordering on the great lakes, in which New York is interested, save the little forty-five mile territory of the state of Pennsylvania.

Now it is the proud boast of the Pennsylvania commission that they take more commercial fish this year than they did last. I am glad of it. I yield to no man on this floor the credit I would give to Mr. Meehan or any other commissioner of fisheries, or any hatchery man. They have my admiration. They have my muscle; they have what little brain I have got, and a good deal of talk.

Now let us see. There is not a state that borders on Lake Erie; there is not a province that borders on the great lakes, that has not a certain element of harmony of law regarding the protection of the food fish of those lakes—save the state of Pennsylvania.

We do not have to go far to find the reason why the representatives of the state of Pennsylvania wish, at this time to kill this resolution. In 1907 out of the four hundred and sixty million eggs allotted to seventeen states, Pennsylvania received two hundred and sixty-two millions; out of eighty-seven million Whitefish eggs allotted, she received fifty-seven million; out of two hundred and fifty-seven million Pike Perch eggs allotted, she received one hundred and ninety-four million; out of twenty-three million Lake Trout eggs allotted, she received two and one-half million; of Lake Herring, she received all taken by the United States over eight million.

In addition to this the New York Department of Fisheries rendered valuable assistance; while the Canadians at the north practically filled two of the Pennsylvania hatcheries with eggs given by the Department of Fisheries.

From this showing collected from the records it is very evident that Pennsylvania seeks to take an unfair advantage in the

great lakes over the other states and provinces bordering upon the same.

Mr. Fullerton: I rise to a question of personal privilege. We are all anxious to get to the other meeting, and let the gentleman speak to the resolution.

Mr. Wilson: I will admit the resolution without further argument.

Mr. Titcomb: By means of this resolution which you want to get through, do you want to take whitefish and also give them a close season?

Mr. Wilson: I want the resolution just as it was accepted by the referee.

Mr. Titcomb: Does that contemplate the protection of the whitefish during the spawning season?

Mr. Wilson: Yes, sir.

Mr. Titcomb: You ought to hear the three papers which are competing for a prize on this very question, as to how to improve the production of whitefish. Every one of those papers makes different arguments, but each one of them advocates fishing for the whitefish during the spawning season when they are in their best condition, and stopping the fishing for them during the period other than the spawning season, but that the eggs of all these whitefish caught during the spawning season be put into the hatcheries. Now the resolution, as you want to pass it, is in direct opposition to the argument of these three authorities. That, I suppose, is the reason that these gentlemen here who are on that committee, have opposed it.

Dr. Birge: Since I have been drawn into this matter by the statements of the gentleman who just had the floor, I wish to say that I did not understand that I was a referee in the sense that the committee was bound to accept what was put before it. Mr. Meehan asked me, since I had proposed this method, if I would not talk the matter over and see if a resolution could not be framed which might be accepted. As this resolution was presented I understood that by the use of the term "fresh water," shad and salmon were excluded from its terms.

Mr. Wilson: Certainly.

Dr. Birge: I understood also, though I did not express this to the gentleman, that I did not suppose that the regulation of fisheries in the great lakes was contemplated in the resolution, since the matter of the regulation of these fisheries is now in the hands of an International Commission, and the regulations are now being drawn up by a commission with which we have nothing to do. I called the attention of the gentleman to the fact that the whitefish of the inland lakes cannot be caught at any other time than the breeding season, but that if this resolution were adopted the association would be bound to maintain that form of protection, and so to exclude these fish permanently from any use whatever in an economic way. I said that I did not believe in that, although my own state has such a law, and the gentleman said he supposed in cases of that sort exceptions would be made, no doubt wisely, by the legislatures of the various states. I knew, however, that there was this exception and called his attention to it, but I saw nothing in the resolution as drawn up, which should have prevented him from offering it to the committee. There was nothing in my relation to it to hinder the committee on resolutions from using the same freedom with that as with any other resolution before them.

President: I want to call attention to one thing, and it is this: Mr. Wilson was speaking to a question of personal privilege. The only matter that could call for debate at present is his resolution to reconsider the vote. Are you ready to discuss that resolution?

Mr. A. Kelly Evans, Toronto, Canada: As the only representative here from the Dominion of Canada, possibly I might be spared a few minutes in consideration of the fact that the Dominion of Canada owns the other half of the great lakes. I have just heard the gentleman who sat down make the statement, if I understand him correctly, that whitefish are caught at no other time but in their spawning season.

Dr. Birge: In the inland lakes.

Mr. Evans: I have lately been partaking of a great many whitefish in my own country, caught at this season of the year.

Dr. Birge: Well, that is not true with us.

Mr. Evans: Well, with us, sir, we have an ample supply of whitefish caught at other seasons besides the spawning season. Further, the policy of the dominion coast has been to respect the whitefish during their spawning season. To me the resolution appears to be one of very great importance. Mr. Meehan is in the happy position of doing more in his state of Pennsylvania for hatcheries, as I understand it, than any state in the union, and is almost reaching that point where he comes within a measurable distance of the total output, as I am informed, of spawn in the whole of the federal government. We, in the Dominion of Canada, are not in such a happy position. We are dependent largely upon the natural habits of the fish to propagate their species. If this society turns down my friend, Mr. Wilson's resolution, it practically places this body in the position of giving an opinion that we must depend entirely upon hatcheries and absolutely not consider the natural functions of the fish as being at all effective in reproducing their species. We in the Province of Ontario feel that in one lake in which New York has a great interest, namely, Lake Ontario, there is only a small portion of that water on our side of the border suitable for the propagation of the natural spawn of the fish, and if you do not consider the resolution of Mr. Wilson it places this body at any rate, as giving an opinion which will help our friends the enemy, the net fishermen of my own province, in carrying on the destruction which has brought the fisheries on our side to their present condition. I will admit that if you have the happy condition that Mr. Meehan has in the state of Pennsylvania, whereby he is able to turn out an immense number of spawn into the water, the resolution possibly is not necessary, but we have not on our half of the border line that happy condition of things, and must at present, depend largely upon the fish carrying on their own natural propagation.

Therefore, I appeal to this body to go very slowly in this question, either for or against it. As has already been intimated, the matter is now in the hands of a royal commission, and I may say to you, Mr. President, that I feel satisfied that the action of this important body last year at Erie, Penn., in passing the resolution which I had the honor to introduce, had something to do

at any rate on our side, sir, in making that treaty possible, and I think the American Fisheries Society has reached that point where any resolution it passes, or any policy that it recommends, will receive the serious consideration, not only of your own federal government at Washington, but of our federal government at Ottawa; and I think that possibly if some arrangement could be made whereby the resolution was neither, as it were, knocked one way or the other, a great good could be done, and I do think, Mr. President, that if you take any action it places you on record, as it were, in upholding the theory that we can get along with hatcheries alone and catch the fish on the spawning ground, if you allow that theory to get abroad, with your endorsement, it will undoubtedly do a great harm to the fisheries of the great lakes.

One more word: I ask any of you gentlemen, who take an interest in this question, to read the report of the Royal Commission, appointed by the Dominion government in 1892, and you will find in the sworn testimony of net fishermen, many of whom are alive today, that the practical destruction of the whitefish of the great lakes was undoubtedly due to fishing during the spawning season. Gentlemen, when you attempt to make science exclusively accomplish what nature has done up to the present, you take an immense responsibility upon your shoulders. I am not a scientist; I do not profess to be one. I have joined this important body for the purpose of receiving an education in the scientific end of the matter, but I say in closing, this: Do be careful in any steps that you take not to give our friends any further advantage of which they will be quick to avail themselves for their own selfish and temporary benefit, to destroy food supply of the masses of the people. (Applause.)

Mr. Charles E. Fryer, England, Inspector of Fisheries: Mr. President and members of the American Fisheries Society, I crave your indulgence as a young member. I am afraid I do not look it and I am afraid I do not altogether feel it, but I am a young member of this society—young in membership at any rate, but possibly with some considerable amount of experience in regard to the various policies that are adopted and suggested with respect to the preservation of fish and fisheries. I had the honor of being elected an honorary member of your society a

couple of years ago, on the nomination of Dr. Hugh M. Smith on, as I understand, the ground that I had had considerable experience in fishery questions outside of America, mainly in England; but not merely as an Englishman but as interested also in the fisheries of the Dominion of Canada and not less interested, being a fisherman, in fish and fisheries wherever they may be found. I desire to express a very strong opinion before you here today, based solely upon the remarks that were made in the northwest corner of the room, to the effect that it was desired to maintain a custom whereby a certain fish, the whitefish, is caught mainly in the spawning season; and I just wish briefly to put these two principles before you: viz., first, that the essence of protection is to protect the spawning fish, both during the spawning season and for a sufficiently long period prior to the spawning season, to enable the roe to fully develop, and the fish to deposit their spawn; and also to protect them for a sufficiently long period to enable them to recover sufficiently good condition to attain the best price in the market.

The second proposition is, that where you have natural conditions interfered with only or mainly by the operations of man in the matter of fishing, not in the matter of other obstructions than netting to fish reaching their spawning beds, not in the matter of pollutions and other dangers to fish life, but simply on the question of fishing, that you will let nature do its work and that you should depend, to the smallest possible extent, upon artificial aids to nature. The conditions are different when you have waters that are available for the development of fish after they have been hatched and placed there, but are only so available. As an instance I will mention a well known case of one of the originally most productive salmon rivers in Europe, namely, the Rhine. In the mouth of the Rhine are the most valuable salmon fisheries in Europe. The principal waters of the Rhine, divided as you know they are among several states, are so absolutely destroyed and cut off from the spawning fish ascending from the sea that, unless artificial propagation were practiced, the Rhine fisheries would be absolutely destroyed; but in your great lakes, to take this concrete case, the whitefish have opportunities of spawning naturally, if they are not caught in undue numbers, and I do submit to you that before you take any action

you consider this matter very carefully. I may say in parenthesis, that I do not quite understand the precise steps which have led up to the present position with regard to this particular resolution; but on the principle of the matter, if you take any action which would suggest that you favor the principle of unrestricted fishing of spawning fish especially, and favor in the place of nature the artificial propagation of fish, you will be giving the greatest set-back to the true methods of fish protection that ever was given to that important matter.

Dr. Birge: I just wish to say a word and that is in objection to the arguments which have been used attempting to commit this body to the assertion of a policy in case of a negative vote on a motion to reconsider. This society has voted in favor of the protection of nest building fish. No deliverance of this body has been made as to the best methods of protecting the whitefish, whether it is by catching and taking the spawn or by protecting them during the spawning season. No deliverance has been made by this body on that question and none will be made, even though this resolution to reconsider is defeated. The only significance of that will be that this body does not choose to give a positive deliverance on that question, one way or the other. Our friend from Toronto thinks it would be wise for this body to go slow in reaching a decision one way or the other, and I coincide with him.

Mr. Titcomb: The gentleman on my right has spoken about the salmon of the Rhine in comparison with the whitefish, in connection with this resolution. I think this society is thoroughly on record as favoring the protection of fishes during the spawning season, but this resolution, if reconsidered, contemplates passing another resolution as I understand it, which involves more particularly the whitefish than any other. At this time and during this congress papers are to be read (and there will be an award for the best paper) telling how to increase the production of whitefish. Now, if we tonight act on this resolution or pass a resolution directly involving that question, it seems to me that we are hasty, and that we ought just to hear these reports that are to be read tomorrow. I happen to be on the committee of award, which will consider these three papers; so I am

talking about what I know; and I hope that the society tonight will not vote to reconsider the resolution on that account, and I call for the question.

President: Is the question on the reconsideration of the vote, or is it on the resolution?

Mr. Meehan: The vote will be on whether the report of the committee adopting a certain resolution as amended shall be reconsidered.

The question was then put and lost.

Mr. Fullerton: Our friend from England misunderstood Dr. Birge's statement about the whitefish. The only time you can catch the inland whitefish is during the spawning season.

Mr. Fryer: I think my remarks have been understood, if the facts are as stated that you can only catch whitefish in the way you mention.

Mr. Fullerton: The inland whitefish.

Mr. Fryer: If you can only catch the inland whitefish during the spawning season and if those inland whitefish are showing signs of falling off, then you are doing an absolute wrong in continuing catching them during the spawning season.

Mr. Fullerton: They are increasing by thousands.

Mr. A. Kelly Evans: If any gentleman wishes to know whether whitefish are caught today in our great lakes I will show him many menus, proving that whitefish are being used today in the Province of Ontario.

Dr. Birge: They are probably cold storage.

President: The papers not read are to be referred to the committee for publication.

Adjourned sine die.

PART II.

SCIENTIFIC PROCEEDINGS

ANNUAL ADDRESS OF THE PRESIDENT

Shortly after you did me the honor of electing me president of the Society, I began to make preparations to leave the country; and I was soon speeding to the remotest parts of the orient, from which I returned only a couple of months ago. If it had been the treasurer, this flight might have looked suspicious and would doubtless have continued longer, but as it was only the president, no special significance needs to be attached to it.

The United States government has shown its interest in the welfare and development of the fisheries of our most distant possessions by dispatching the fishery steamer Albatross to the Philippines for the purpose of determining the aquatic resources of the islands and pointing out the lines along which the fisheries may be improved and the financial condition of the Filipino fishermen bettered. This work is still in progress and will continue for a considerable time. On his way to the Philippines, your president made a short stop in Japan and renewed acquaintance with some of the interesting fisheries of that most interesting country; and he visited a national fishery exhibition at Nagasaki at which there were more than 28,000 special exhibits. He also had an opportunity to see something of fishing in China, and made a special inquiry regarding the celebrated pearl fisheries of Ceylon. About these foreign fisheries and the lessons they afford us, something may be said at some future meeting.

Matters of great importance connected with the fisheries have come up since our last meeting. The year has, in fact, been characterized by almost unprecedented activity in fishery work and will be found to have left an enduring impress on the history of our fisheries.

In view of the impetus this society gave to public fish culture in America, it is a pleasure to note the steady growth of this most important branch. All over the country it is receiving greater attention; new hatcheries are springing up everywhere under private and public auspices; thousands of persons every year are experiencing for the first time the benefits and delights

of private pond culture; and the proneness to overindulgence in meat is being offset by the increasing opportunities to have wholesome fresh fish as regular components of our menu. The demand for food and game fishes for stocking public and private waters is taxing the capacity of the hatcheries to the utmost, and the response is seen in a larger output in the past year than ever before in the history of the country; but the supply of many kinds of fishes is entirely inadequate, and this fact is exemplified in the insistent demand for fish hatcheries in recent congresses which culminated in a remarkable movement in the last session of the last congress, when there were presented ninety-seven bills, providing for seventy-four new fish cultural stations in forty-two states and territories, and carrying appropriations aggregating $2,000,000.

The progress of fish culture in America, however, must not be gaged solely by the magnitude of the operations. Equally important are the perfection in methods and the enhanced efficiency of the results that have been brought about by the scientific study of the fishes, their eggs, and their food in nature and under domestication, and by the investigation of the physical, chemical, and biological characters of the waters to be stocked. Never before has the man of science co-operated more zealously and effectively in the interests of the fisheries; and never before has the debt that the practical fisherman and the fish culturists owe to the scientist been more generally acknowledged. The necessity for scientific knowledge in the handling of fishery problems is so fully appreciated that those states which do not now have trained biologists connected with their fishery work are regarded as behind the times.

The increased attention given to oyster culture is one of the most hopeful signs of fishery advancement. The persistency and vigor with which the inauguration of oyster planting was for a long time opposed in some states was most disheartening to all who had given the subject serious study and had seen the futility of the do-nothing policy to which some of the states seemed to be irrevocably committed. The state that had the most at stake and was one of the last to recognize the benefits of oyster farming is Maryland; but having finally seen the error of her way, she has approached the subject of the restoration of her suprem-

acy in oysters in the proper spirit and has instituted a system of surveys, preliminary to the general allotment of lands for planting purposes, that for comprehensiveness and thoroughness are marvels and will serve as models for the remainder of the country. It is hoped and believed that in Maryland and other states an industry meaning so much to the citizens thereof and to the country at large will never again have to suffer because of party demands, and that hereafter oyster planting will have no greater political significance than corn planting or potato planting.

A movement that augurs most important benefits to our fish life is the national conservation commission, appointed and assigned a definite task by the president of the United States. The general and unqualified approval of the purposes of this commission on the part of the state authorities and private citizens as well as federal officials is one of the most encouraging signs of the times; and I venture the prediction that when this commission shall have made its report and recommendations it will be seen that the relations of our fish life to agriculture, forestry, mining, irrigation, and other industries are fully appreciated and that ample provision has been made for the conservation of our interior and coastwise fishery resources.

A dispute that is practically coexistent with the United States is that involving the fisheries carried on by our New England fishermen on the shores of the English colonies on the northeast coast of North America. Treaty after treaty, modus vivendi and modus vivendi have sought to define and limit the rights and privileges of the fishermen with so little result that on more than one occasion a war cloud has appeared on the horizon and gained considerable size. It is therefore a source of great satisfaction to all concerned that this long standing dispute, by mutual agreement, will now be submitted to the international arbitration tribunal at The Hague.

The apparent inability of the states to unite on measures for the protection of the fish life in the basin of the great lakes, and their willingness to have the federal government assume jurisdiction over the fisheries in all the boundary waters contiguous to the United States and Canada, have resulted in a convention with Great Britain under which an international commission has been appointed and assigned the duty of drawing up regulations

that will be binding on the fishermen on both sides of our northern border. This is the first instance in which the government has attempted to exercise jurisdiction over the fisheries in state waters, and marks an epoch in the history of fishery legislation in this country.

In conclusion, there should be named among the things that make this time noteworthy from the fishery standpoint, the Fourth International Fishery Congress, whose sessions begin in this city tomorrow. It will be recalled that this society united with the United States government in extending an invitation to the congress to meet in America this year, and the society thus becomes a joint host. With great magnanimity you have consented to curtail your regular sessions in order that you may attend the meetings of the international body. I believe that your course in this matter will be fully justified and that you will feel at the end of the week that you have had one of the most profitable and enjoyable fishery experiences in your entire existence. I hope that every member of the society will become regularly affiliated with the Fishery Congress, so that he may participate in all the functions that have been provided.

DESCRIPTION OF SAN MARCOS STATION WITH SOME OF THE METHODS OF PROPOGATION IN USE AT THAT STATION

BY JOHN L. LEARY, UNITED STATES BUREAU OF FISHERIES, OF SAN MARCOS, TEXAS.

The San Marcos Texas Station is situated near the head of the San Marcos river and about three-fourths of a mile from its source, which consists of bold flowing springs, flowing from a limestone ledge some one hundred feet in height. The station comprises thirty-three acres of land and has a river front of nearly one-half mile and about eighteen feet above water level of river, the grounds being located east of and adjoining the town, a street being the dividing line, and are quite picturesquely situated just below a range of hills one hundred feet above the general level of station, the hill just back of the station being crowned by a very handsome state building known as the Southwest Normal School of Texas, accommodating about five hundred students, and makes a fine background to the station, which, with its miniature lakes, makes a pretty foreground, the two making a picture which I call the gem of southwest Texas. Of these grounds we have nine acres devoted to twenty-three ponds, varying in size from fifty by fifty feet to one by one and one-fourth acres, all being designated by letters or numbers. Each pond has a separate inlet and outlet. The inlets are provided with gate valves, and the outlets or standpipes are of brick and cement, open fronts, screened with perforated zinc screens which I have found to be most efficient. The perforations being one-sixteenth of an inch, both screens and dam boards fit into slots provided for in the mason work. The supply pipes are from four to six inches as to size of pond, and the outlets from six to eight inches, leading into drain pipe twelve inches in diameter. All pipes, both supply and drain, are laid under ground, and consist of Michigan pine, terra cotta, and iron, the iron being preferred as they never become clogged with roots which will permeate both the

wood and clay pipes and at times giving serious trouble. The water supply consists of one artesian well, with an average flow of about five hundred gallons per minute, and a ten horse power gasoline pumping plant. This plant gives after two years use, six hundred gallons per minute, the two supplies giving barely enough to supply the twenty-three ponds, owing to the fact that we have nearly nine months of summer.

The station was fitted up for a black bass station, water conditions being quite suitable for the large mouth variety, they only being propagated and with them we have been quite successful. We also propagate the two crappies, bream, warmouth bass, and rock bass, all doing well except crappie; the water conditions of the station seem unsuited to their propagation.

We have also tried to propagate the blue channel catfish for the past three years, but have met with total failure. On coming to this station some twelve years ago I had made up my mind that 1,000 shipping fish to the pair of breeders would be a fair result (I mean by shipping fish—young fish from two to six inches long). I now think that sixty per cent of that number is a fair average, however, our plants of fish two to six inches have been wonderfully successful, in fact we have not met with a failure to stock any waters where we have made plants of black bass. With our perch, excepting bream, we have never had abundant results. This is caused to some extent by devoting a small water area to their propagation and this has been caused by the great demand for the black bass.

The method of work pursued at this station is to conform as near to nature as possible. The ponds were constructed so as to have the largest area of shallow water, thus securing in early spring an abundance of natural food, and protection for our young fish, and all breeding ponds are provided with gravel nesting places. I at one time provided artificial nests, with varying success. These, with other experiments, their failure and success if told would take up too much space in this paper. I have found that the first great essential is to provide the very best breeding fish to start with. Not the very large and possibly old fish, but fish that will run from two and one-half to three pounds, well proportioned; not the long race horse kind. Fish, like everything else have their fine points. The nearer they are of

one average size, the better. One other thing I find helps in pond culture and that is to infuse new blood as it were into your breeding ponds. That is, each year introduce a fair per cent of wild fish into your ponds, discarding all breeders that have a rundown appearance. The number of breeding fish will vary with climatic conditions. In this climate—southwest Texas—I say that sixty good breeders to the acre of water surface seems about the right number. Where the climate is cooler and ponds deep, this number might be doubled to advantage.

We have two seasons for the distribution of young fish from the San Marcos Station, the distribution of black bass commencing in the spring about the middle of April, and extending to July or August, and as soon as the fall sets in, giving cool weather, we distribute all bass left over, our crappie, rock bass, bream and other fish. Most of the bass shipped from this station run from two inches early in the season to six and eight inches in the later part of the season. Fish of this size being quite acceptable to applicants, they get fewer in number, but with a positive certainty of satisfactory results in stock waters planted.

In collecting young fish from our breeding ponds for shipment we use a seine made of bobbinet, rigged in the same manner as the large drag seines are for commercial fisheries. The young fish, seined from the breeding ponds, are assorted and placed in shipping pools. These pools are constructed of brick and cement, six by sixteen inches and two feet deep, provided with valve inlets, and six inch outlets, and can be emptied and scoured in a few minutes. From these pools the messenger takes them, carrying of the smaller size, two hundred and fifty to the can, or of the large size, fifty. During transportation the messenger seldom changes water, but uses ice to keep the water temperature down to sixty degrees, and under these conditions even in our summer climate seldom loses a fish, and the general report of applicants is, that fish are received in good order, and later that results are satisfactory. We supply with the station force over four hundred applicants each year, and artificial lakes and ponds in the state are on the increase, creating the need of another station in Texas.

I have brought some photographs of my station in connection with this article, showing our grounds and pond system, and will

say that we have one of the most attractive spots in Texas, apart from the pleasure we are giving to sportsmen, and the economic good we are doing. It is an oasis, you might say, in the midst of this sunburnt country, at least it looks and feels that way to me.

DISCUSSION.

John W. Titcomb, Washington, D. C.: I note what Mr. Leary says about his total failure in the attempt to propagate the blue channel catfish. The bureau has attempted to propagate this species of catfish at five or six different pond stations and carried the brood stock for a number of years without any result whatever. Apparently the fish spawn in a rapid flowing stream or in the current of a stream under the river. Mr. Worth has made some experiments, and Mr. Leary's failure is not the only one. I think the value of his paper would be enhanced if he would explain, as I am sure he can, why the crappie is a failure there.

Mr. Leary: In the first place, the conditions for crappie are not such as they usually breed under. Crappie usually breed in roily water, and our water is clear. I have succeeded, however, in raising crappie by introducing carp with crappie, which roil up the water, and I have raised some thousands of crappie in that way. I have also resorted to nearby cattle tanks and stocked them with crappie, and I have got fair results from stocking such ponds. These ponds are supplied by rainfall and the water seems entirely suited to their propagation.

Mr. S. G. Worth, Beaufort, N. C.: It would appear that the spotted catfish has been actually propagated by the government. Since I was in Tennessee engaged in that work under Mr. Titcomb, I have discovered that the annual report of the United States Fish Commission for 1892 and 1893 shows that Dr. Rudolph Hessel, late superintendent of the carp ponds, Washington, hatched thirteen hundred of those fish; and they were distributed through the central station, of which I was then in charge, and are recorded in the table of distribution by their name and also by the scientific name, and in view of the numerous failures that have taken place, it is rather encouraging to think that some were actually hatched, and especially under Dr.

Hessel, because we know that he was a very accurate man in his work, and I think that the history referred to is worth looking up.

Dr. James A. Henshall, of Montana: What crappie did you experiment with, the sparoides or the *annularis?*

Mr. Worth: Both.

Dr. Henshall: I would only state that in the middle west in Kentucky, the *annularis* always spawn in clear spring ponds, as does the calico bass or the sparoides in the lakes of Wisconsin and Minnesota. Those lakes are always clear and the fish spawn naturally. Of course, it makes some difference in case of domestication.

President: Will Dr. Evermann say a word in regard to the catfish from the biological standpoint, and the possible cause for failure of artificial propagation?

Dr. Barton W. Evermann, Washington, D. C.: I do not know that I could say anything that would help the matter at all. I am not very familiar with the spawning habits of the channel cat or the spawning habits of the blue cat of the Mississippi valley, and I take it that in the experimental work in the station, or fish cultural work there, it is desirable to propagate both of those species, and probably the difficulties which you would encounter with the one would be essentially the same as those which you would encounter with the other. In the years that I spent in the Mississippi valley, it was my observation with both of those species of cat (particularly the channel cat) that while they would live in the moderately swiftly flowing streams, such as the Wabash, we would find them in the spring of the year at spawning time, in holes in the banks of the streams. It was quite a common thing for us to go after the channel cat in that way, and in the spring of the year to find it in the holes in the banks, and the supposition was that that was its spawning place. I do not know that that is correct, but it may be. At any rate that may offer a suggestion as to the habits of the fish.

In all of this work it is of the utmost importance, I think, that we should know what species we are dealing with. As Dr. Henshall raises the question regarding two species of crappie

and calico bass, the habits may not be the same; in fact, in most cases we know that they are not the same, and we should be very sure that the species that we *think* we have is the species that we really have. We all know, of course, that it is very difficult to determine some of the species of catfish, particularly the common black bullhead and the common bullhead, the *ameiurus nebulosus*, as distinguished from the *ameiurus melas*, and sometimes shipments have been made of some of the little stone cats under the impression that they were yellow cats, or that they would grow to be important commercial fishes; so that the only point I want to make is that we should be sure of the species that we have in hand.

Dr. Henshall: I endorse what Dr. Evermann has said about the catfish making holes in the bank. I presume all of them do that.

Mr. Worth: The catfish from an economic fish cultural standpoint, has interested me considerably, more especially since I have noticed that Dr. Henshall claimed to have hatched them, and that fact taken in conjunction with the statement of Dr. Jordan that he regards catfish as being as good a food fish as the blass bass, makes the subject an important one. For my own part I do not care for catfish, but I know that it is a good food fish in a general way; and the point that I wish to make is this: It seems that as a rule, as a general thing, the spotted catfish cannot be propagated in ponds, but under exceptional conditions that it may be successfully propagated. Now if that is the case, if it can be propagated and does not ordinarily reproduce itself in ponds, it gives that fish an advantage over any other representative of the finny tribe that we have in the United States. It gives us a good food fish that will take a miscellaneous diet and that will not reproduce while we are feeding and growing it to table size.

President: The chair will state that the introduction of the spotted catfish and the fork-tail catfish of the Mississippi valley into the Potomac river has proved one of the most interesting and important experiments in acclimatization that we have undertaken. A few fingerling spotted catfish were placed in the Potomac river near Washington a number of years ago, and in

due time the anglers began to report the capture of fine specimens of a catfish that they were not familiar with, and three or four years later they began to catch another species of catfish also strange to them, and when we secured specimens it was found that they belonged to a species of which we had no record of introducing. So that the probability is that there were young fork-tail cats with the spotted cats. Now these fish are caught in large numbers by anglers above and below Washington, but more particularly in the swifter part of the river above the city, and I believe I am safe in saying that there are few fishes known to the sportsman of this vicinity which are more popular than those big cats from the Mississippi basin. They take the artificial fly almost as readily as the black bass, and as a food fish they have few superiors.

THE INCREASE OF WHITEFISH AND LAKE TROUT IN LAKE ONTARIO

BY CHESTER K. GREEN, UNITED STATES BUREAU OF FISHERIES, OF CAPE VINCENT, N. Y.

There has been such a marked increase in the catch of whitefish and lake trout in the waters of Lake Ontario, in the vicinity of Cape Vincent, N. Y., due to the work of the Bureau of Fisheries, at this point. I concluded that a few facts and figures which have been gleaned from the fishermen and fish dealers would undoubtedly prove of interest to this society.

The actual results of the work conducted by the bureau did not make itself manifest to a perceptible degree, until the season of 1907, and the increase for the season of 1908, has been still more remarkable.

From the branch of the A. Booth Fish Co., located at Cape Vincent, I have obtained the following comparative figures showing the quantity of fish received by them from the fishermen on the American side. From January 1, 1907 to December 31, 1907, whitefish, 1,128 pounds; lake trout, 1,608 pounds. From January 1, 1908 to September 15, 1908, whitefish, 5,765 pounds; lake trout, 4,864 pounds, showing an increase of 4,628 pounds of whitefish and 3,256 pounds of lake trout, with nearly two months fishing remaining to be accounted for this season. These fish were taken principally in the vicinity of Grenadier Island, located about eight miles from Cape Vincent, and practically with one set of nets.

The Booth Company have also informed me that from the Canadian waters in close proximity to Cape Vincent, they have received more than five times as many whitefish and trout this year than last, and last year's catch greatly exceeded that of any previous season for a dozen years or more. I had arranged with the company to give me the exact figures up to date, but owing to the unfortunate turn in their financial affairs, they were unable to collect the data. In order to present some definite figures, however, for a stated period I herewith reproduce the following

extract from my last annual report to the Commissioner of Fisheries. The A. Booth Fish Co. report that the increase of whitefish and trout in the waters of this vicinity over last season has been remarkable, and have given the following comparative figures of actual weights for a stated period.

Whitefish and lake trout received from April 1 to June 10, 1907, 30,523 pounds; whitefish and trout received from April 1 to June 10, 1908, 120,905 pounds. I am informed that the same rate of increase has been maintained during the entire season.

The fisheries from which a large percentage of these fish were produced, are located at the Duck Islands, about twenty-five miles southwest of Cape Vincent, and very close to the American boundary line, and from twelve to sixteen miles from where large deposits of fry have been made annually during the past twelve years.

It must be remembered that there is not at the present time one fisherman on the American side to at least twenty or thirty on the Canadian side, and therefore we have no means of knowing to just what extent our fisheries have been benefited.

Last season the bureau secured from Three-Mile Bay, N. Y., about seven miles from Cape Vincent, 720,000 whitefish eggs. These were obtained from adults produced from fry distributed from the Cape Vincent station, and represent the first whitefish eggs taken in this vicinity in many years. There was but one net in operation last season, but owing to the encouraging prospects, there will be prepared four large nets, for use this season, with which it is anticipated much larger results will be obtained, and thus demonstrate the practicability of securing large supplies of whitefish eggs, for the purpose of artificial propagation.

The laws of the state of New York, now provide for a close season for whitefish, from November 1 to January 1. The Forest, Fish and Game Commission have, however, granted permission to the fishermen at Three-Mile Bay to take whitefish during the month of November, for the purpose of collecting the spawn. The state commission will also co-operate with the bureau in the matter of the distribution of the fry, extending this work to the depleted fisheries of Lake Ontario from Chaumont Bay to Oswego, N. Y.

There has also been an excellent showing made from the plantings of pike perch fry in this vicinity. Last fall two hundred pounds were brought in at one time by a licensed fisherman, and several fine specimens have been captured with hook and line during the past summer, one of which weighed six and one-half pounds.

It is gratifying to note that the value of the work of the bureau is fully conceded and appreciated by the fishermen and dealers. They are thoroughly in accord with the aims and objects of the commission, and in some instances are taking measures to regulate the size of the mesh of their nets. It is hoped that all may be induced to do so, and thus prevent the catching of undersized fish, and the marketing of the same.

VALUE OF CARP AS FURNISHING FOOD FOR BLACK BASS

BY DR. S. P. BARTLETT, UNITED STATES BUREAU OF FISHERIES, OF QUINCY, ILL.

In discussing this proposition I wish it understood that I deal with the conditions present in the Mississippi and Illinois river business in Illinois. That there may be a variation in conditions in other localities is probably true, but I know of no better place to show possible practical results from the introduction of the carp for purposes given in the title, than in localities named.

I am aware that what I say may be considered as emanating from an enthusiast on the question, or perhaps to put it plainly, it may be thought that I have said so much about the carp and its general value, that I believe it myself and therefore do not hesitate to state it as a fact. I am, however, pleased to know that time has demonstrated beyond question, that the United States Fish Commission did a good practical job when carp was introduced in waters named.

For a moment I would like to consider the conditions present when fish are taken from the overflows and natural lakes and ponds. My observations have been that a very large percentage of coarse fish are always found in such places when the water becomes very warm during the summer months, say eighty-five per cent of coarse fish which would include carp, buffalo, bream, catfish, shad and the minnows, to fifteen per cent of the various varieties which would include bass, pike or pickerel, crappie, perch dogfish and gar, and I believe these proportions are nearly or quite maintained in the rivers proper. These conditions, I believe to be natural and for a purpose, namely, the coarser fish to supply food to the gamier. If I am correct in this proposition, the necessity for a great amount of food supply exists in order that the bass and other live feeders may be maintained and failing in such supply, naturally consume their own fry and so far as possible, each other.

Way back in the sixties, buffalo furnished the bulk of coarse

fish taken for shipment for market and the rolling or spawning season was the harvest for those engaged in commercial fishing, and the catches along the Illinois and Mississippi rivers were immense, and the product sent to St. Louis and other outside markets by steamboat usually packed in large sugar hogsheads and barrels. I can remember of seeing shipments so large that in spite of the perishable nature, only a part of the shipment could be taken. A large proportion of these fish were lost as little or no ice was used, the boats making the trip usually during the night. The fish were as a general thing consigned and account sales very frequently showed so great a loss that freight charges were not realized.

While the slaughter, for such it was, was in progress, the catch of bass, pike, pickerel and crappie was very large, immense quantities shipped all through adjoining states to good market.

In 1870 to 1880 the decrease in supply of buffalo was marked, in fact, had decreased to an extent that most of the larger fish dealing companies had gone out of business. The bass were notably scarce, pike and pickerel practically extinct and all game varieties had greatly decreased. Attention had been called to the matter by this time and in the early seventies legislative action was asked for and some tentative laws passed covering spawning seasons. The harm, however, had been accomplished and fish were scarce.

Then came the introduction of the carp. Carp increased, so did the opportunity for "cuss words" and complaints without number, that the carp were destroying and driving out game fish, yet carp increased, so did the bass. Carp furnishes the great bulk of commercial fish and bass are more plentiful than ever known on Illinois river. On the Mississippi river, owing to the peculiar conditions of the overflows, not so general or complete, the banks being as a rule higher, carp have not shown nearly so rapid an increase and bass equally as scarce.

It might be well to give a few of the facts gathered in the years I have spent along these rivers, to show why I attribute the increase of black bass to the increase of carp, or in other words, increase of food supply. As stated under natural conditions, the percentage of coarse to fine fish is largely in favor of the coarser varieties, and this has been a notable season along these lines.

The Illinois river was high and out of its banks all fall of 1907, and remained so practically all winter, and in fact, all of spring of 1908. This gave an opportunity for general spawning of fish in the back waters. The season showed up with great quantities of black bass fry from off the nests fairly early, when water had receeded to an extent that made collections possible, we found great quantities of yearling bass, but in such places as we found the yearling bass we found no fry, or in very limited quantities, and when fry of 1908 were found in quantities, we found no yearling or large bass. In the river proper along the shores, one and two year old bass were taken anywhere on hook and line and in great quantities, and the fry of the carp notably scarce.

Some immense catches were made. I note one particularly. Three men took in three hours, at the mouth of a slough running out from one of the flat lakes, 375 black bass, from one-half to three pounds in weight.

These fish were brought up to Meredosia and cleaned. I had an opportunity to examine the stomachs of a large number and I am safe in saying that the large percentage of food found in them could be recognized, was of carp fry. The carp, of course, spawn anywhere and the deposit of spawn great, making it possible not only for a reasonable percentage of fry to escape and reach maturity, but furnishes at same time a great amount of food for other fish and it is presumed the bass get their share of them and anything else handy, not overlooking when hungry, their own young.

There is perhaps no need to say to you who have had as much experience as I have had, that black bass are live feeders and feed to feed and not for fun. An instance or two that may furnish a straw in support of the theory advanced.

One season (date not in mind) while collecting bass for the United States Fish Commission at Meredosia, we concluded to use for storage purposes a spring pond situated near our plant. This covered perhaps a half acre, and while well filled with brush, we tried to clean it out and did take out quite a number of adult black bass and we found that the pond was well supplied with bass fry of the spring hatching, just off the nests. Mr. Bawr made an estimate of the fry at 50,000. We were making

collections then at or near Copperas Creek dam, some distance above Meredosia, by use of a small steamer and had taken from one large flat lily pond about 40,000 bass fry. As I remember it now, Dr. T. H. Bean, at that time with the United States Fish Commission, was with us on one of the down trips. We put the fry so collected into the spring pond to hold until cars were available for distribution. Some weeks after we drained the pond as best we could to take the fish out for shipment and we found 5,600 good fat bass fry as the remnant of the 90,000 (estimated 50,000 and counted 40,000) that we should have had.

At another time, I put in the fountain basin in Washington Park, Quincy, 12,000 black bass fry, taken from Quincy Bay, all sizes. We were not ready to ship them and had no other means of holding them here, except in life box. Here we had a constant supply of running water. I had men take from the bars in the river, what I estimated at 100,000 shiner minnows and feed them together with an occasional feed of beef liver. I do not remember of taking out a dead bass, but when we had arranged to ship them and the basin was drawn down we took out less than 1,500 bass fry, fat and slick, and not a dead fish.

I quote these instances; two, of a great many that have come under my observation, to show the great need of plenty of food for the bass under any condition and when under natural conditions largely furnished by the carp, reduces the destruction of its own spawn by the adult bass or other various species.

While this paper should be confined to the subject, I cannot refrain from digressing a trifle and calling attention to the fact, that in my opinion, not enough care is used by those making the attempt to cultivate bass in small ponds to get a proper balance in the ponds in the way of food producing facilities and some very lamentable instances could be given showing failures when only black bass culture was attempted.

It would be well to remember that while I have much to say of the black bass that is good, I have more to say of the carp that is better, when the people as a whole are considered.

With us the angler goes his length on the black bass, and they who can afford day or days of leisure to cast a fly, troll a spoon, or "dub fish" with a minnow; should give due credit to the causes that make this sport possible and not overlook the thousands

who cannot afford rod or net, fixed bait or even minnows, who sit on the bank content to catch, with such tackle as he can get and such bait as may be procured without cost, this same carp, for food for himself and food for the fish the angler fishes for.

DISCUSSION.

Secretary Peabody: This is one of our most interesting subjects, gentlemen, and has heretofore provoked considerable discussion.

President: It out to be explained that the subject of carp has been tabooed in the American Fisheries Society for several years, and Dr. Bartlett has taken advantage of the withdrawal of the prohibition to let us hear from him on this subject.

Dr. Bartlett: I hope the members will not take it that I should be affronted if they criticise the paper, or criticise it severely. I have been used to that for a great many years. I want to say that I have lived long enough to see all of my efforts perfectly justified, not only in my own state but in a great many states surrounding, and I have this to say, that the United States Fish Commission never did a better job on earth, that produced more food for less money than when they introduced the carp in the waters of the state of Illinois.

Dr. Barton W. Evermann: I have recently passed across the continent from New Brunswick to Vancouver Island and heard the carp damned every day. I thought the damning that the carp received on the American side was severe, but it is mild compared with that which you hear across the border. No one in Canada has a kind word for the carp. No one seems to know anything about the carp except to make the unfounded statement we have heard so often, about its destructiveness in various ways.

On Lake Erie the fishermen are getting more carp than all other species combined, and are getting more money in the aggregate for the carp than for all other species combined, or for any other species, throughout the year. A little later on the upper Mississippi river near Dr. Bartlett's own home, the fishermen were catching little but carp at the end of August and early days of September, and although they were getting but three or four cents a pound for it, it was bringing more money than they were

getting from all other fishes, so they have said. There are those who will tell you that the carp is destructive, that it eats gallons of eggs of whitefish and all other fishes, but such statements are usually very recklessly made. One person showed a carp which he said had a gallon of whitefish eggs in its stomach in June. (Laughter.) The eggs were not whitefish eggs, but were the carp's own eggs, (laughter)—not that it had eaten them, but they were in proper place—a little delayed but still there. (Laughter.)

President: We have with us today a number of gentlemen who can tell us a good deal about the carp and its destructive habits in Europe, and I am sure it will be a great pleasure to the society to hear from one or more of these gentlemen. I would like to call on Dr. Hoek for a brief statement of the attitude of the European public toward the carp in open waters so far as the destructiveness of the fish is concerned.

Dr. P. P. C. Hoek, Holland: I should like to give you an answer, but I cannot, as I am not sufficiently acquainted with the habits of the carp. But perhaps Dr. Nordquist may know.

Dr. Oscar Nordquist, Lund, Sweden: In Sweden we are doing all that we can to increase the carp, but I must tell you that the carp does not spawn there in free waters in the lakes. We cannot get it to spawn in any other way than in small ponds built just for the spawning of the carp, but we never have noticed any destructive qualities in the carp. We consider it to be one of the best fish we can introduce. It is possible that in climates warmer than ours carp propagate more rapidly than with us, but there it does no harm. There is no fish I think, which can utilize the food, existing in a lake, so well as the carp does, but that I think is the only way in which it can do harm to other fishes. I have seen in American papers that by roiling and making the water muddy it may do harm, but that we have never noticed in Sweden, and that is the only thing I can say. We consider the carp a very good fish.

I think the reason why people have got an antipathy for the carp is that they eat it directly from muddy water, and that of course is a great fault; for if a carp is taken out of muddy water and brought directly to the kitchen it of course has a muddy

taste; but you have to put it in clear water and keep it there alive for some weeks and then the muddy taste disappears, and it is just as good a fish as any other. The same holds true of a lot of other fishes; if you take them directly from muddy water they have a muddy taste. That is the only explanation I can give why the carp are so disliked here in America.

Mr. Charles G. Atkins, East Orland, Me.: Let me suggest that carp is probably condemned in America without a fair trial; that of ten thousand who condemn the carp probably not more than two or three have ever tasted one. People make up their minds without trial, or knowing what the truth is.

Let me make another suggestion, whether the carp is not really good enough to be considered as a fish worth growing for its own sake instead of merely to feed other fishes, and whether it would not be worth while to try to start with the production of carp and not use carp up in the feeding of other fishes that in the end are no better. Rather than use ten pounds of carp to produce one pound of bass, would it not be better to utilize the ten pounds of carp, and then we would have ten pounds of good fish instead of one pound? I ask whether it would not be better for us to abstain from so much cultivation of the predaceous fishes at the expense of the more peaceful fishes like the carp?

President: We have heard from northern Europe through Dr. Nordquist; we would like to hear from southern Europe through Dr. Vinciguerra.

Dr. Decio Vinciguerra, Rome, Italy: In Italy the carp is little appreciated and is not cultivated. A certain Austrian gentleman tried to cultivate carp in northern Italy, and though he met with success in the culture he failed in the trade of the fish, because the fish was too expensive for the common people; and he could not sell in Germany because the distance was too great; I think he gave up his ponds.

SOME POINTS IN THE MIGRATION OF PACIFIC SALMON AS SHOWN BY ITS PARASITES

BY HENRY B. WARD, OF THE UNIVERSITY OF NEBRASKA.

The Pacific salmon manifests some strange features in its life history which are of such interest as to call for whatever evidence can be secured to establish their precise character. Two years ago through the courtesy of Commissioner George M. Bowers of the Bureau of Fisheries, I had the opportunity of spending a summer in Alaska investigating the parasites of the salmon. My sincere thanks are due the bureau and Commissioner Powers for this unique opportunity to study a most interesting subject. While the large amount of material collected there has not been put in final condition for the complete report and in any event would be rather too extensive to warrant repeating it here, yet there are certain results of such general interest that they may properly be presented on an occasion of this type. This is all the more true since they cast a most interesting light on the comparative biology of the Atlantic and Pacific salmon.

It is possible to gather from the parasitic fauna of any animal clear evidence of its habits. Even though the knowledge be incomplete one may demonstrate some of the changes through which the animal has passed. In fact the parasites of any animal will show clearly the range of its dispersal, the period of development it has reached, the character of its food material, and the type of medium in which it lives. Whatever changes, usual or exceptional, are experienced during its career leave a record of their character in the list of its parasites.

To illustrate this it is only necessary to cite one or two interesting examples in order to place clearly before your minds the general principle I have just stated. In 1899 Linton found that eels caught in the sea harbor parasites which are primarily marine in origin and secondarily of fresh water type. Even more striking is the observation of Zschokke (1902) in his studies on the lawyer (Lota vulgaris), which is the only fresh wa-

ter representative of a great marine group, the codfishes. The lawyer is parasitized by a few species found in hosts that are confined to fresh water. On the other hand it shelters many parasites that are characteristically frequent in marine fishes and usually absent among fresh water hosts. Thus though a time interval of unknown length has intervened between the present and that period in which the lawyer established its fresh water habit at yet it shelters parasitic forms which are characteristic of its old associates and has acquired little new infestation from its fresh water home. The records might be multiplied but they indicate clearly that a study of parasitism will yield valuable evidence to confirm or reject proposed hypotheses with reference to the origin, migration, and habits of our fresh water fish. It should accordingly be looked upon as a biological criterion of the most useful type. The primary object of this paper is to consider the side light which a study of its parasitic fauna throws upon the migrations of the Pacific salmon so far as they are instanced in Alaska.

Apparently no records have been published concerning the effect of migration on the parasites of fishes with the exception of those given by Zschokke and others who have worked upon the migrations of the European salmon. The results Zschokke obtained are presented in three papers (1889, 1891, 1902) and give a most comprehensive review of conditions in the case of the Atlantic species as observed on the shores of Europe. If I may be permitted to follow somewhat closely his account, the case stands as follows:

Richly laden with parasites the Rhine salmon, Salmo salar, enters upon its journey in fresh water. In the course of its wanderings it loses more and more these parasites which inhabit the open intestines below the pyloric coeca; and since it fasts while ascending the Rhine, and thus the door for the invasion of parasitic worms is closed, it secures no fresh supply. Even thus the salmon at Basel affords an unusually rich booty of parasites, harboring more than twice as many species as any fresh water fish at that place. There still remain in the fish the inhabitants of the anterior part of the alimentary canal and those which can retire there so that parasites which in other hosts inhabit only the intestine, occur in the stomach and oesophagus of the Rhine

salmon. To such must be added also those forms which lie in the pyloric coeca with their rich store of reserve food as well as others which are encapsulated in various parts or move about freely in the body cavity or other closed organs. But even those parasites in the oesophagus, stomach, and pyloric coeca appear to decline in number of species and individuals as the fish remains longer in fresh water and climbs higher in the streams. Finally the salmon harbors only the encapsulated forms and those lying in various entirely occluded organs. The wandering in the Rhine constitutes thus a cure for the elimination of parasites from the alimentary canal. Some investigators, indeed, though without the exact knowledge afforded by these demonstrations of Zschokke, have proposed to explain the migratory instinct of many fishes on the basis of the necessity of relieving themselves of parasites acquired in the ocean.

The salmon which ascends the streams from the Baltic sea feeds abundantly in fresh water and harbors accordingly some fresh water parasites while the intestinal region does not become free from parasitic infestation. It possesses even a richer parasitic fauna than the Rhine salmon.

Other somewhat less extensive observations yield evidence of the same type. Thus the Elbe salmon according to Fritsch (1894) takes absolutely no food and in a corresponding way is infected by a parasitic fauna of a purely marine type. Over against this must be placed the record of McIntosh (1863) that the Tay salmon does feed to some extent during its migrations in fresh water. Even here the marine element preponderates, and yet there are not wanting a few parasites recognizable as guests which normally frequent fresh water fishes. In the Tay salmon also the parasitic fauna is numerous and varied. It embraces a considerable number of forms which occur in the intestine behind the pyloric coeca just where it will be recalled the Rhine salmon is entirely free from parasitic infestation. Both this infestation of the intestine and the large percentage of parasites which may be characterized as fresh water forms are regarded by various authors as clear evidence in support of the fact that the Tay salmon unlike its relative of the Rhine does not cease taking food when it enters fresh water. Consequently the marine elements in its alimentary canal are gradu-

ally lost and are replaced in part at least by the fresh water intruders. The parasitic fauna of the Tay salmon becomes thus altered during its migration but is not so greatly reduced in numbers as in the case of the salmon from the Rhine.

These observations upon the Atlantic salmon in different streams indicate clearly that as a certain individual it is characteristic of the parasitic fauna of the same host taken in different localities. This fact seems to have escaped emphasis at least at the hands of previous investigators. They have been most strikingly impressed by the fact that the parasitic infestation reaches the minimum when after spawning this salmon starts on its return to the sea. Elsewhere I have called attention to the interesting biological parallel between the later condition and that of the hibernating frog and marmot. In general one may say that the reproductive period constitutes the terminus of a physiological cycle and the host starts on its new cycle unincumbered by the parasitic guests of a former period.

In view of these interesting results from the investigation of parasitism in the European salmon you will understand with what pleasure I accepted the courteous invitation of Commissioner Bowers to investigate the parasitic diseases among the Alaska salmon. While the European work was all done on a single species, Salmo salar, in which local races or varieties are recognized by some students, the Pacific salmon appears in five species of more or less common occurrence and commercial importance: the King salmon *(Onchorhynchus tschawytscha)*; the Red salmon *(Onchorhynchus nerka)*; the Cohoe or silver salmon *(Onchorhynchus kisutch)*; the Humpback salmon *(Onchorhynchus gorbuscha)*; and the Dog or Calico salmon *(Onchorhynchus keta)*. In my work especial attention was paid to the Alaska or Red salmon which is the most abundant and most important commercially of those species in the Ketchikan district in which I was located. A total of one hundred and thirty-eight specimens of this fish from various portions of the district were examined from the time at which the fish appeared early in June up to the time of spawning about September 1. The material examined included such as was taken from salt water and also specimens from fresh water lakes at different periods of time so that the series would give a reasonable view of the con-

ditions at the time when this fish first appears on the coast together with the changes which might be experienced through its migration and stay in the lakes preliminary to entering upon spawning. The number examined was large enough to enable one to speak definitely regarding most of the facts observed. On the other hand the number of individuals examined from the other species, namely: 31 humpback, 21 silver, 10 king, and 9 dog salmon, is too small to establish accurately the facts concerning them. So far as one can observe generally the results substantiate those obtained from the examination of the red salmon.

It has been stated by various authors that these five species have generally similar habits and food and it is rather striking that in spite of this agreement they manifest marked individuality with reference to the parasitic species which they harbor. One is inclined to think that the cause may be a difference in range during the long unknown life in the deep waters of the ocean from whence these fish come suddenly into the estuaries at the approach of the spawning season. The difference in the parasitic infestation of the species indicates clearly that in some way they carry on a different mode of life. The evidence at present at hand is insufficient to decide whether they actually use somewhat different types of food or whether they seek this in different regions.

The first specimens which are caught early in the year either in the salt water or in the brackish water of the estuaries frequently have the stomach filled with recently ingested food. Among twenty-five such specimens only seven had any parasites in the intestine while of ten, entirely without food in the stomach, nine had parasites in the intestine. A month or more later it was impossible to recognize in any case definite masses of food in the stomach of the red salmon. Yet about the same percentage of the whole number harbored intestinal parasites. Apparently then the taking of food or the cessation of feeding has in this case little or no influence on the presence of parasites in the intestinal canal. One may proceed, however, one step further along the same line. Red salmon were taken during July and August from fresh water lakes where they were waiting and ripening for the spawning period, and these individuals showed the same variability and the same relative degree of parasitic

infection in the intestine as those which were taken from salt water at the beginning of migration. I should note in passing one apparent exception to this rule. The red salmon taken from salt water contain occasionally specimens of a large tapeworm closely related to *Bothriotaenia infundibuliformis*. This species was not found even in a single case among the specimens taken from fresh water. Summing up then the results of the investigations on the Alaska salmon in this particular one may say that intestinal parasites are variable and infrequent at all times. Contrary to the findings of Zschokke for the Rhine salmon the parasites do not disappear from the intestine at any time in the migration, with the possible exception that this single large cestode seems to be wanting under conditions of fresh water existence.

Such parasites as exist in the pyloric region are apparently not affected by the migration although the large cestode previously referred to was not found in those hosts which had attained the fresh water lakes in the vicinity of the spawning grounds. Since, however, this species is not frequent in any series of specimens representing this host, its absence at the end of the migratory period may be entirely without significance. Parasites of the stomach and oesophagus are as varied in species and nearly as abundant in numbers at the close of the migratory period as they were at its outset. Furthermore, I am unable to find that these organs shelter during the fresh water existence any of those species which at an earlier time inhabit the other posterior portions of the alimentary canal. Consequently so far as the Pacific salmon is concerned its migration does not affect appreciably the amount or variety of its parasitic fauna. The parasites of the body cavity include an interesting and abundant form which is not known to occur elsewhere. This seems to be as numerous and as active in the fish on entering the spawning grounds as in the fish from salt water. Numerically it constitutes one of the most important elements in the parasitic fauna in the Alaska salmon and has no parallel in the forms hitherto reported from the European salmon.

As in the case of the Rhine salmon, so the individuals of the Pacific species are reported not to take food after they leave the salt water. In my examinations I have not found food mate-

rials in the stomach except in rare cases when I detected some small objects not necessarily of food character which had apparently been swallowed by accident. The alimentary canal becomes highly modified in appearance during the period of migration. At first one finds considerable quantities of white mucus present. This becomes much reduced in volume and changes until only a little more fluid material remains and this is of a greenish hue. These changes have no apparent effect upon the parasitic fauna. Those forms which were present at the start were still present at the close of the migration. To be sure in some fish which were examined last or which apparently had been longest in fresh water I discovered a few cestode larvae which seemed to be of recent introduction but this, which may be designated as the fresh water element, was relatively insignificant. The forms were small in size and never more than few in numbers.

In one respect the aspect of the salmon changes markedly. After a stay in fresh water it acquires regularly large numbers of a parasitic copepod, which line the oral cavity and gills. I have never seen a single specimen of this on a salt water fish. It may be regarded as a striking fresh water contribution to the parasitic fauna of the Alaska salmon. Of course this gill parasite has no relation to alimentation since it is introduced during the acts of respiration and fastens itself to the mucous membrane of the mouth and gills as the current of water passes through. The cestode larvae noted above are the only forms which by any possibility could have any connection with food matter taken in fresh water. Consequently the purely trivial increase is strong confirmatory evidence of the fact that the Alaska salmon does not feed during its fresh water existence. In this respect then the Alaska salmon manifests an evident biological similarity to that of the Rhine. In other respects there is manifested a distinct biological contrast. In the Alaska salmon the parasites are reduced little if any in number during migration and the percentage of infection is exceedingly variable in specimens taken under all the varied conditions. Furthermore, one may maintain positively that at the close of the migratory period after a long stay in fresh water the parasitic fauna of the

Alaska salmon is still varied in character and still to be found in all regions of the body.

Evidently the results of this study stand in sharp contrast with those obtained by Zschokke and outlined above. They are thus both entirely unexpected and difficult to explain. Since they were secured by the examination of a single series of salmon they must be verified by careful work on the same host in other localities before they can be finally accepted. However, there is another fact which should be borne in mind. The Alaska salmon not only belongs to an entirely different genus from the European but it also has a radically different life history in that it perishes after the reproductive elements are discharged and never returns to the ocean to start upon another physiological cycle. Consequently this prominent physiological factor stands in radical contrast with the repeated migrations of the Atlantic species and one might reasonably expect to find other radical differences in the biology of the two species.

It is interesting to note that this limitation of life with a simple reproductive period coupled with the failure of the salmon to return to the sea is of considerable influence on the biology of the parasites it shelters. As we have already seen, the salmon carries large numbers of parasites into fresh water and since it does not return they must be left there. Among these forms are both adults and larvae. The parasitic life of the fresh water inhabitant does not seem to acquire any effective addition from the parasites which are introduced in this way since the examination on many hosts both in and about the lakes and streams failed to disclose the salmon parasites in any phase of their life history. To be sure some of the encysted forms may easily reach maturity in the birds or mammals which feed upon the migrating salmon; yet not only are such instances exceptional but they also present conditions which make it difficult to conjecture the means by which the adult salmon could be reinfected. It is evident also that the mature parasites of the migrating salmon discharge their ova into an environment where conditions for further development are hardly present. Even if the embryos should complete successfully the first stages in their life history they have no chance to reach the adult salmon which is their final host. A single distome which occurs in the trout of the

streams and lakes as well as in the adult salmon may owe its introduction into fresh water to the migrating fish for it would be difficult to conceive that its presence in the adult salmon dated from the time at which the young fish were feeding in fresh water before they went out to sea. In any event this instance is unique. The introduction of the parasite is unquestionably of long standing and it may be possible to explain the case on entirely different grounds.

It is evident then that the vast majority of parasites which the migratory salmon brings into fresh water streams and lakes in Alaska can find no further possibilities of existence. They perish without completing their life cycles or effectively propagating their kind. This large number of individuals which are thus of no avail in the perpetuation of the species forms a part of the reproductive surplus which is prominently discernable in all parasitic organisms. At the same time the removal of these parasites from the range of the growing salmon tends to reduce the degree of parasitic infection and to keep this host with the relatively low percentage of parasites which characterizes it in comparison with other marine fish.

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DISCUSSION.

Dr. Barton W. Evermann: I would like to ask Prof. Ward one question: Whether his studies of the parasites of the Pacific coast salmon show that those parasites are of fresh water relationships or salt water relationships, and if the anwer to that

question throws any light upon the probable origin of the salmon whether of fresh or salt water origin.

Prof. Ward: Dr. Evermann's question is one of extreme importance and one reason why I omitted mention of it in the paper was that I did not want to have to give an opinion on it. The total inventory of this fauna is so extensive that I am not quite sure about the fact but the conspicuous species are of salt water character. I have not yet carried to ultimate identification all of the forms. The amount of material is rather large and the amount of work associated with its exact comparative determination also great.

I think that this may be said: I did find in salt water fish in the estuary, some of the same parasites; but I did not find in fresh water fish in the lakes, any of the same parasites with the possible exception of that one little distome which I mentioned.

Mr. Charles G. Atkins: It might be of interest to mention here some of our observations on the habits of the Atlantic salmon in American rivers. We have been at work cultivating them in the Penobscot river for many years. During some of the early years, at the request of the original commissioner, we made some observations on their food. I had the market men in the town of Bucksport save for us the stomachs of the salmon they were cutting up, and I sent about one hundred of them to Washington, and the experts reported that in the whole hundred they found nothing which could be called food. Those fish were bound for the spawning ground at that time. Every year from that time we have confined some hundreds of these fish captured in May and June, alive in a small enclosure till late in October in a fresh water stream, but never offered them food. Occasionally, if any of them died, we would examine their stomachs and see in what condition they were, and they did not seem to be capable of taking any food at that time. The stomachs would be much contracted; the walls very thick and solid, so that it seemed impossible for them to swallow food and manipulate it as usual in the stomach.

Dr. P. P. C. Hoek, Holland: In regard to the comparison of the parasites of the Rhine and Pacific coast salmon, the discussion is very interesting; but there remains a little point that

I hoped to have considered. There is another group of parasites than those mentioned, and we made observations on them. They are really ectoparasites; they are found on the skin of small trout, and found also on the small salmon during the first year of its life. The Rhine salmon does exactly as young trout does, and in that time it is infected just as young trout are, and with the very same species of parasites. I think it is curious that large salmon returning to the sea after having spawned, are infected with that same form. They are not very numerous but from time to time we catch in the mouth of the river salmon returning from the Rhine and going to the sea. Now with your permission I should like to ask Prof. Ward whether he has any information as to the Pacific salmon being thus infected also, and I thank him beforehand for his kindness in giving me that information.

Prof. Ward: That is a very interesting question. It can be answered easily, but it brings up a larger question. There is no similarity in parasite fauna between the Pacific coast salmon and the Rhine salmon; and when we compare the Pacific salmon with the Maine salmon we find more similarity between the Pacific and Maine salmon than we do between the Maine salmon and the Rhine salmon. I presume all ichthyologists would put the Maine salmon and the Rhine salmon very close together, but they would not put the Maine salmon and the Pacific salmon very close together. A year ago I had the privilege, through the courtesy of the Bureau of Fisheries, of studying some salmon in Maine, and the parasitic fauna of even the land-locked salmon from Sebago Lake was more similar to the parasitic fauna of the Pacific salmon than to the parasitic fauna of the Rhine or Elb salmon from the other side of the ocean.

President: While we are on this subject of the salmon, and because of the fact that there may not be another opportunity to bring up the matter again, I should like to call on Mr. Meehan for a statement of what he hopes to accomplish in the way of acclimatizing the Atlantic salmon in a river so far south as the Delaware.

Mr. W. E. Meehan: Mr. Chairman, the establishment of the Atlantic salmon in the Delaware river is somewhat a pet

topic with me. The stream is presumed to be below the latitude in which the Atlantic salmon is supposed to be naturally found.

As far as I have been able to find out by looking back at the records, no true salmon were ever found in the Delaware river in early days. But there were so many features about the river indicating that it ought to be at least a good brood stream and attempts were made in that direction.

The first efforts made to establish Atlantic salmon in the Delaware river were about 1870, when Thaddeus Norris and some others procured a lot of eggs and hatched them and planted them in tributaries of the Delaware river near Easton. One of the streams in which they were planted was known as the Bush-Kill, which emptied into the Delaware at the mouth of the Lehigh. Four years after, a number of salmon came into the Delaware river, and five or six were caught in nets. A few were found trying to make their way into the Bush-Kill at Easton.

A second trial was made and with the same results, but as there were only about half a dozen fish or so caught or seen, the experiment was considered a failure.

Nothing was done then for a number of years, but in 1890 the late Henry C. Ford, then president of the Fish Commission, and myself, made a very close examination of the Delaware river, particularly the upper waters, and knowing of the experiments of Thaddeus Norris, felt convinced that there was a reasonable chance of establishing fish in the stream. We secured a lot of eggs (I think the first lot of eggs was 60,000) from the United States Bureau of Fisheries. They were hatched at our station at Allentown and planted in the streams of Wayne county. The following year we secured about 200,000 eggs and they were planted in the same waters, and also in the stream called Blooming Grove, belonging to what is now known as the Blooming Grove Hunting and Fishing Club. In a very few months the fish showed up in large quantities in these various streams. There were so many, in fact, in the Blooming Grove that the club stopped all trout fishing in that stream, because they caught more of the little salmon than they did trout. They were seen shortly afterwards in the river. In 1894 there was a little run of salmon in Delaware river. In 1895 there was caught $5,000 worth of salmon in the Delaware,—fish that were put in the

market freely, found in every restaurant of any size in Philadelphia, and the price before the season was over, went down from 50 cents to 25 cents a pound. They were caught in every shore net and several gill nets took salmon weighing from eight to twelve pounds.

Shortly afterwards Mr. Ford died and the Fish Commission, when they got the eggs and young fish, insisted on planting them to suit particular localities, some in the Susquehanna, and some in the Delaware near Easton, the statement being made by the then commissioners, "If Mr. Norris thought it good enough for Easton it is good enough for us"; and the result was inconsiderable. But salmon have been caught year after year since then up to this last year. Last year, as far as I have been able to find out, no salmon was caught; but last year a dead spent salmon was found—a fish weighing about twenty-four pounds—at the mouth of the Bush-Kill at the line between Pike and Monroe counties.

Hence, it is very evident to me that if from a planting of one year of 60,000 and another year of about 200,000, such a number of salmon should come back into the river, there is no reason why we should not believe and feel that it is possible to make a salmon river out of the Delaware by persistent stocking. I believe, of course, that the best fish to go in there is the Atlantic salmon.

The great difficulty we have met with is to secure eggs. There seems to be some law which prohibits the exporting of eggs from the Dominion of Canada into the United States, and the trouble I have met with therefore, up to the present time, is in the securing of eggs.

I believe that the only way to make a salmon river out of the Delaware is by hatching and planting large quantities of young fish in the tributaries of the streams such as these clear cold streams abundant in Wayne county, emptying into the Delaware.

We made experiments with the quinnat and it was a dead failure. We planted them in the tributaries, the same streams in which we planted the Atlantic salmon, and not a single fish was seen after they left the streams. They were seen in the little streams during the summer months but that ended them.

We made some efforts to domesticate the Atlantic salmon but

met with failure. I have half a dozen fish which reached spawning size out of four thousand. I think Mr. Atkins can say something about his efforts to domesticate the Atlantic salmon. I think they were not much more successful than mine.

Last year after a talk with Dr. Smith and Mr. Bowers of the Bureau of Fisheries, we made a trial with the silversides, it being a fish that spawned presumably about the same latitude as the Atlantic salmon. We received some 90,000 or 100,000 eggs, and from the eggs we hatched the fish at our Wayne station, planted a large percentage of them in the streams, and they are at present doing as well as could be expected in those streams with the low condition of the water due to the drought. We have saved a number of the silverside salmon in the endeavor to domesticate them, and I have here a bottle containing a specimen of the silverside salmon which we have reared and which were hatched this season. These fish are but a few months old. (Specimen exhibited.)

They feed as well as the brook trout and there seems to be no reason why we should not now raise those fish to mature size. Whether or not we can succees in establishing them in the Delaware is another question, but I have hopes from the character and size of the fish which we are now rearing that we may be able to do so.

Mr. Charles G. Atkins: As Mr. Meehan suggests, we have at the Craig Brook station tried the experiment several times of domesticating the Atlantic salmon, that is, domesticating them to fresh water, and we have each time succeeded in getting them up to the spawning age and getting eggs from them, but they did not grow full size. Instead of growing to ten or fifteen pounds in size they were only three and four—the largest of them—and not apparently in very good condition; and the eggs that we obtained from them and the young hatched from them were of inferior quality. It is quite possible that the inferior quality may have been owing to faulty feeding. Perhaps we fed them on the wrong material, and if we had had the best material to feed them on, such as live insects or fishes, or something of that sort, it is quite possible we might have produced good eggs and good offspring from those salmon, but as it was it was not satisfactory, and there did not seem to be any object

in continuing the experiments, because if we did domesticate them and accustom them to fresh water, they would be no better than the land-locked salmon, which are already by nature accustomed to fresh water, and so we discontinued further experiments.

Mr. B. O. Webster, Bellefonte, Pa.; An Atlantic salmon which we now hold in Bellefonte has grown to be fourteen or fifteen inches in length.

Mr. W. T. Thompson, Leadville, Colo.: A point was brought out along the line of the Pacific coast salmon which was rather the subject of Mr. Ward's paper, but we did not get all the information that might be given on that subject. I think the Bureau of Fisheries must be able to furnish a little more about the success or non-success of the efforts to introduce the Pacific coast salmon into the Atlantic waters. Some of us are not well posted on the results, and if we could induce the commissioner or Mr. Titcomb, or some one to give us a little information, I think it would be appreciated by all.

President: Will Mr. Titcomb respond to Mr. Thompson's inquiry with regard to the success of efforts to introduce Pacific salmon on the Atlantic coast?

Mr. Titcomb: I have no statistics, but my impression is that 5,000,000 of salmon fry were planted in the tributaries along the Atlantic coast from Maine south to the Connecticut river, and possibly a little further south. They totally disappeared. Since then we have been trying the silver salmon and the humpbacked salmon in the rivers of Maine. It seems that the habits of these fish are more likely to be suitable to meet the requirements of these shorter rivers along the coast of Maine, and we have some hopes of success. They were planted in quite large numbers; some as fry, some as fingerlings three or four inches in length. They are both very hardy fish and easily reared to that size, but I cannot report any results as yet. I can report favorable results from the introduction of the chinook salmon *(Oncorhynchus Tschawytscha)* in fresh water lakes. In New Hampshire lakes they have been caught weighing nine or ten pounds, and have attracted the attention of the anglers. We do

not know yet whether they will reproduce when they have become wonted to the fresh waters or whether they will have the same habits of the salmon of the Pacific coast and die after spawning. But in two or three lakes in New England this salmon has been introduced successfully, so that it has been caught by the angler up to the size of nine or ten pounds, and proved a very gamey fish.

I do not dislike to discourage Mr. Meehan in his efforts, but today the bureau is maintaining a commercial fishery for the Atlantic salmon on the Penobscot river purely by artificial propagation. If that river were left to its own resources and the natural productiveness of the salmon, I think they would disappear in a very few years. We find it difficult to get enough eggs to keep up our stock; and Mr. Meehan has stated the difficulty of getting enough eggs to stock the Delaware. There is no place in the United States where we can get them, and if we could feel encouraged and have the courage that he has about the artificial propagation of salmon we would naturally try to stock the rivers farther north which are naturally better suited to them, and were once their natural habitat, like the Connecticut, the Kennebec in Maine, and the Merrimac which were once teeming with salmon, but now are almost depleted, if not entirely so, due to the pollution of the waters and the artificial obstructions which naturally come with the progress of civilization.

Mr. Meehan: Perhaps my courage may be due to the fact that I feel that today there are not many streams in which commercial fishing is done that could be maintained without artificial propagation; and if it were not for that there would not be anything of any kind in the waters. But I do believe that if we succeed in putting salmon in the Delaware, artificial propagation would have to be continued, and continued on a large scale at all times, and never stopped. In fact, we do not dare stop at that in any kind of work, for whether it be whitefish, herring or trout, or whatever the fish may be, it is artificial work today that is keeping the streams up.

Mr. Frank N. Clark: Why is not that the proper way anyhow? (Applause.) Take your eggs, hatch your fish, plant them in the water, and take your old fish out, just the same as you do with beef cattle on the farm.

Mr. A. H. Dinsmore, Birdsview, Wash.: I would like to ask why fish could not be purchased from commercial fishermen, as Mr. Atkins does, and retained there as he retains his fish, and then why the product from those fish might not be used?

Mr. Meehan: We might possibly do that.

President: Is there any evidence whatever here that the mature Atlantic salmon which has been induced to run in the Delaware, has ever spawned?

Mr. Meehan: The only evidence I have had in that respect is that last year a dead spent fish was found floating in the river at the mouth of the Bush-Kill at the border line of Pike and Monroe counties—a large fish weighing twenty to twenty-four pounds.

Mr. Titcomb: Male or female?

Mr. Meehan: Female, of course. (Great laughter.)

Mr. Titcomb: Not necessarily.

Mr. Meehan: In Pennsylvania when we speak of a spent fish we always mean a female. (Laughter.) I imagined that it was so generally.

Mr. Titcomb: When you are older you will feel differently.

Mr. Meehan: Possibly, but there were seen also in the Bush-Kill large fish attempting to clamber the falls at Reseca—evidently trying to get up into the pools above. That was three years ago.

QUESTION BOX.

Mr. Fearing: Has anyone had any personal experience in stocking waters with striped bass?

President: Mr. Fearing's inquiry has, I presume, particular reference to the depletion of the streams of southern New England and the middle Atlantic states, and he and others have been advocating extensive planting of striped bass fry with a view of restoring those waters.

Mr. S. G. Worth, Beaufort, N. C.: Mr. Chairman, a good many of us are familiar with the stocking of the waters of the

west coast of the United States with the striped bass, which has been pre-eminently successful. That was done with small members of the striped bass family, caught in the eastern waters by nets and otherwise, and shipped across the country. As far as I know that is the only stocking in those waters that has taken place. The cost of fry is a different thing to measure. The cost of the fry at the station on the Roanoke river, North Carolina, run by the United States government, has amounted for several years together now to something like $300 per million. The cost has been that high for the reason that I have had too many fishermen on my payrolls and too many fishermen out of the river drawing salaries as spawn takers and not in fishing. It is my opinion that those striped bass eggs can be produced in North Carolina at a smaller cost than what I have given. For many years the cost of shad fry from the hatcheries of the United States was about $70 to $75 per million. I do not know how it is of late, but the using of fry for stocking purposes is certainly a practical thing today. Fry are easily moved, easily put in small ponds, keep well and grow fast.

Mr. John W. Titcomb, Washington, D. C.: The striped bass problem seems to be a good deal like the Atlantic salmon problem on our coast. It seems to me that the fishery all along the coast is going down every year. As I understand it, these streams in which Mr. Fearing is interested, are already natural streams for striped bass, and inhabited by them, so that it is merely a question of introducing a small number, as when the striped bass were carried to the Pacific coast. It appears that there is no hope for the striped bass on the Atlantic coast in the future unless we can have uniform state regulation, or what would naturally follow that, federal control, which will regulate the fishing for the striped bass in the bays where the water is salt or brackish, and where the fish are taken in large numbers before they can leave the spawning bed. It is the same problem which we are facing now in the preservation of the shad, which have disappeared practically from the rivers of the north, and are gradually disappearing from the Delaware where Mr. Meehan wants to introduce the salmon, and in the other rivers further south, and where we have only one instance of improvement, that is, in Albermarle Sound, where the state has adopted regu-

lations which seem to tend towards preservation.

We cannot today get the spawn of the striped bass in sufficient amount to promise any young fish for the northern streams, and there is no fishery on these northern streams of sufficient importance to warrant us attempting to secure spawn there.

President: Referring to the inception of the striped bass culture on the Pacific coast, is it not a fact that more eggs can be obtained there than at any point on the Atlantic coast, so far as our information goes?

Mr. Titcomb: I could have said so last year but not this year. Mr. Lambson, can you tell how many eggs we got this year?

Mr. G. H. Lambson, Baird, Cal.: About two and one-half million.

President: How many last year?

Mr. Lambson: I don't know. Mr. Titcomb has the statistics for last year, but I think it was about 7,000,000.

Mr. Titcomb: It was very encouraging last year for the first year's attempt; but that is where the striped bass is more abundant today than in any other waters of the United States, and we made very persistent efforts this year to secure eggs, not only through the bureau under the direction of Mr. Lambson, who is able to take care of over 100,000,000 salmon eggs every year, but also under the direction of Mr. Vogelsang, the deputy fish commissioner of the state of California. It is very difficult to get ripe females and at the same time ripe males.

Mr. Frank N. Clark, Northville, Mich.: Has there ever been any attempt made to pen them—to hold the males or females, or both until they have ripened?

Mr. Titcomb: Mr. Worth has had some experience in that direction.

Mr. S. G. Worth, Beaufort, N. C.: We find it impracticable to do it. The high temperature of the water at that time, about seventy-three degrees renders it impracticable. We do not succeed at all.

Mr. Clark: For what reason? Did the females plug and fail to ripen? Did they die or what?

Mr. Worth: They seemed to become covered with fungus rapdly, and to become sick and weak, and turn white around the fins: and it was no use—we tried it three or four times.

Mr. Titcomb: How large were the pens, Mr. Worth?

Mr. Worth: We had pens made of large, soft netting and held off with stakes and strips at the bottom, so that they were about six feet square. We did not make any experiments in long runways of water, like races.

Mr. Clark: Nor ponds built in the natural stream?

Mr. Worth: No, we made an honest effort to do that but got no results.

Mr. Clark: You made no effort to hold the fish except by penning them in these six-foot square pens?

Mr. Worth: That is true.

Mr. Clark: You did not have longer pens—sixteen or more feet?

Mr. Worth: We did not.

Mr. Clark: And you did not build pens right in the river and allow the fish to have free access to the bottom, whatever it might be.

Mr. Worth: We did not. Our pens were not as thoroughly and successfully arranged as they ought to have been, considering the importance of the subject, but in all that we attempted we failed.

Mr. Titcomb: In speaking of the penning, I have always been in hopes that we could put a rack at some point near Weldon on the Roanoke river, where Mr. Worth is operating, similar to those used on the Pacific coast. The objection to that is probably the fact that the people on the river above, would oppose it very strenuously, but I have a theory that if we could hold the striped bass in the river at some point we might get

together a large enough number to warrant continuing their propagation. Just at present the bureau is considering the advisability of the entire abandonment of the propagation of the striped bass at Weldon. I think we may continue another year on the Pacific coast in hopes that we may do better work there. When you speak of the output of eggs, I would say that Mr. Lambson reported two and a half million which he hatched. He took seven, eight or nine million, but the rest were poor eggs. That number is a mere bagatelle. One female bass will give you as many as 2,000,000 eggs sometimes. So when you report having taken after a season's efforts 15,000,000 eggs of the striped bass, it is nothing at all; it represents only half a dozen fish out of the whole river for a whole season's efforts. The rest have spawned the natural way.

Mr. Clark: I do not wish to rise here in the way of criticism at all, but I would advise this: If the bureau wishes to push striped bass work when they get the female bass when it is not ready and the male is, let all efforts be bent on that penning. In the first place you get a quantity of fish—

Mr. Clark: Oh, you don't—I thought you did. (Laughter.) You have got to get fish, of course; but when Mr. Chase first commenced penning whitefish on the Detroit river twenty-five or thirty years ago, I said at first, you cannot do it, but he did, but not with very good results till later on; but at first they met with the same difficulty until they got to building the crates right; got them in proper place and the fish got the proper amount of water. Even now we drive in stakes and build a little pen in the river and let the fish have the natural water. I should want to try all those plans for penning the fish. If you get fish that are not ripe, hold them and try all sorts of ways; because if you can get twenty-five or fifty fish and get them in ripe condition, you will have a lot of eggs; and I should not want to give the experiment up until I had used every effort on the question of penning. We tried the shad until every one was satisfied that we could not pen them, but there were not merely hundreds of dollars spent on the penning proposition with regard to the shad, but thousands and thousands of dollars and I helped spend it, and it was a failure.

Mr. Titcomb: Mr. Worth has explained pretty fully about the methods of catching the fish down there. They are caught by people as much for sport as a commercial industry. These men go out in boats at night with bow nets and dip nets; go along the bottom and scoop up the fish. Mr. Worth, in his efforts to get males and females together, has established seven telephone stations and if he catches a female at one station and another station has a male he tries to bring them together by telephone. (Great laughter and applause.) It is not a question of penning a lot of fish.

Mr. Worth: The boatmen have co-operated with us in this matter, but before we had telephones we lost some eggs. There have never been any seasons in the last five or six years but what we could have got twenty, thirty or forty, but we never got more than fourteen. The first fish was taken there about five years ago. It was a twenty pound striped bass from which we got over 2,000,000 eggs on the basis of 35,000 to a quart. Those are accurate figures and of course it does not take many fish to make an enormous output.

Mr. Titcomb: I don't know but what I ought to revert to that salmon question for a minute. When I stated that on the Penobscot river, the maintenance of a commercial fishery is entirely dependent upon artificial propagation, I referred to a condition which does not exist, as I understand it, anywhere else in the country. We propagte fish all over the country, but we also rely on natural reproduction. In many instances a mere brood stock of a certain species of fish put into a lake is all that is necessary; nature takes its course and the lake becomes well stocked, but if we should discontinue this artificial propagation on the Penobscot river the commercial fishery for salmon would become extinct in a few years, because we have very little evidence, if any, at present, that any of these salmon reach the spawning ground. Now our method of obtaining eggs there is by the purchase of salmon from the commercial fishermen. These salmon are caught in weirs as they ascend the river in June or July. This year we pay in the neighborhood of $3.75 for every salmon we buy, both male and female. It is an expensive proposition, and the cost of operating a hatchery

for the maintenance of the salmon on the Penobscot river is almost equal to the returns from the commercial fishery. I do not speak for the Bureau of Fisheries, but personally it is almost a matter of sentiment whether we should maintain that hatchery or not, because of the conditions today—the returns are so discouraging in proportion to the outlay.

LIFE HISTORY OF THE COMMON EEL

BY DR. THEODORE GILL, OF THE SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

Dr. Gill: Mr. President and gentlemen of the society: I am quite unprepared to speak now as I had no expectation of being called upon, but I will make a few remarks.

As you are all aware, the eel has never been found with developed ovaries or spermaries, in fresh water. The absence of such organs, so conspicuous in most fishes, has led to some remarkable conjectures and hypotheses respecting the nature of the generation of eels.

One of the most persistent of those hypotheses is that they were generated from mud, from putrefaction. That has been maintained from early times and has been persisted in by educated men as recently as two centuries ago. Sir Thomas Browne was one of the first to cast a doubt upon the allegation that eels were generated from mud. In contradiction Augustus Brown, a writer of the same period, treated the allegation as being axiomatic. In other words, he said, speaking of the generation of mice from Egyptian mud, upon which Sir Thomas Browne had cast a doubt, that it was as true and could be relied on as certainly as, among other things, the generation of the eel from mud. Of course, such a belief has long since ceased among educated people, but still persists among many of the uneducated. It has taken a long time to come to the truth; in fact the true conclusion has been reached only within the last two years. (The finishing touches, indeed, have not yet been made, and probably will not be made for a long while.) I wish now to refer especially to the late discoveries of Johannas Schmidt and Dr. Gemsöe.

It is still believed by many persons, as you are all aware, that eels do breed in fresh water; that they must breed there because eels are found in places that are apparently inaccessible; but of course all such ideas must be discarded at once, as there is no basis for the belief that eels, under any circumstances, ever

breed in fresh water, or anywhere near fresh water. It is hard to pursuade some men that such is the case, but nevertheless it is a fact.

Now the eels not only do not breed in fresh water, but they go a long distance out to sea before they are able to breed. Up to the time that they are found in the estuaries and the fresh water of rivers, they still are destitute of developed ovaries and spermaries, unless examined with a microscope when these organs may be seen in a rudimentary condition.

The eels then go out to sea, so far as regards the northern European species, going out into the Atlantic Ocean, into water of the depth of at least a thousand meters; that is, over 500 fathoms to put it in round numbers, and it is only under such conditions that they can breed. Meanwhile as they are advancing into these depths doubtless the ovaries and spermaries become developed, and the eggs must be deposited in the depths. But they are floating eggs, having oil globules they ascend towards the surface. They are at last hatched and in the later months of summer or fall, young eels are found perhaps hundreds of miles from the coast on the high seas as leptocephali. Now it must take some months to pass through the condition from the time that the mother eel leaves the estuaries until the time when those eggs are developed and the young leptocephali appear at the surface or near the surface.

These young then come out in the form of leptocephali, entirely unlike the mother eel, being very transparent, ribon like, very high and very much compressed, so unlike the mother eel that some ichthyologists long considered the leptocephali, which are merely the young of the various eels, as being a distinct order of fishes. For many years one species from northern Europe was known as the leptocephalus morrisi. That form was long the only one known, and that is nothing but the young of the conger. It is only within a few years that two eminent Italian naturalists discovered the true nature of the leptocephalus form of eel and connected by gradnation this leptocephalus form with the eel. It was a species that had been only known before as found in the Mediterranean. Now it was believed, by some at least, that the common eel was generated in the same way as the conger, that is, by means of a leptocephalus; but this

was doubted on account of the supposed absence in the North Sea of any other specimen than the leptocephalus morissi. At last, however, the leptocephalus of the eel was found in great abundance by two special expeditions sent out by the Danish government under the naturalist Johannas Schmidt. He found these leptocephali in great abundance in the ocean remote from land, and, as I said, in water of the depth of about a thousand meters. He traced them from that place until they approached pretty near to the land. Even when they get into the estuaries they are still translucent, and in that condition they are known in France as civelle, and they have different names in other places, and are regarded in fact as a delicacy. They are translucent then, but still they are not the same as the leptocephalus found in the high seas; they have already assumed the subcylindrical form.

That is the condition; I will not go into detail. But we have now the evidence of the development of the eel from the condition of the leptocephalus until it has arrived at a mature state. Now it must take about eight years to complete that life cycle, that is, from the egg to the adult form, and it is only when the eel has been six and one-half to eight and one-half years in fresh water that it goes down to the rivers. The eel can of course live in fresh water for many years, but while there it does not develop its generative apparatus, the ovaries or spermaries. The full details of this I will give in a paper which I will present later. (Great applause.)

DISCUSSION.

Mr. Charles G. Atkins, East Orland, Me.: I have had myself some opportunity to make observations on eels and their generation, which may be of interest. I should say about thirty years ago when engaged in capturing land-locked salmon at Grand Lake stream in Maine, we captured them by means of traps which took the fish descending from the lake trying to get into the stream; all the fish were taken moving down with the stream instead of upward. Occasionally we caught large eels, and I found them filled inside with an immense mass of what appeared to be white fat, but under the microscope it turned out that that white fat consisted of eggs, and while I do not

quite dare to say positively, yet I believe the number of eggs taken from each fish ran into the millions. I estimated them by weighing small quantities of the mass and counting the number of eggs in that mass. I do not remember ever coming across anything which appeared to be the generative organs of the males. So I suppose all I examined were females. They were very large and bound down the stream; and it is a common phenomenon of those rivers every fall to find great quantities of eels moving down the stream in a good many places. It has been the practice to capture them in large numbers and send them to market at that time, and I had supposed that this conclusion might be safely drawn, that the eels ascending into fresh water did mature their ovaries, and then at certain times moved down and went to sea, and laid their eggs; and that when the young reach a certain size, which may be three or four inches in length, they ascended the rivers. I have seen large numbers in rivers such as the Kennebec, three or four inches long, an immense mass of them, perhaps twelve to eighteen inches wide (I have noticed them as a boy) and so thick that one could hardly see the bottom through the mass. I have seen them moving steadily up the river right along the shore, and at Craig Brook where I have charge of the station now, we constantly find little eels all the way from three to eight or ten inches long, running up the stream; sometimes we catch a hundred of them in a night—little bits of fellows. We keep traps there set constantly, because we fear they are enemies of our young fish; we know they are when they are full grown, so we try to trap and reduce them in that way, and I supposed it was well established that it was their natural way to come up into fresh water, spend some years, get their growth, mature their reproductive organs, and then go down to sea to lay their eggs. My observations have been somewhat limited, but I feel sure that I found the eggs in those eels and reported the fact to Washington at the time.

Mr. C. H. Wilson, Glens Falls, N. Y.: I want to say that I

Note.—On referring to the original records it is found that one female eel contained three or four millions of eggs one one-hundred-twenty-fifth of an inch in diameter—the estimate being carefully made.

received a letter from Ex-Governor Smith of Vermont, who has a preserve in one of the provinces, stating to me that he spent six months making a study of the eel with a microscope, and that his conclusions were the same as those of Dr. Gill.

Mr. W. C. Thompson, Leadville, Colo.: Does the eel spawn more than once?

Dr. Gill: No, they die after spawning.

Mr. W. E. Meehan, Harrisburg, Pa.: Did I understand you to say that eels died after spawning?

Dr. Gill: Yes sir.

Mr. Meehan: That is not in accordance with out experience. In the spring of the year in the Delaware river and in the Susquehanna, there is a run of eels up the river of large size, that is, nearly as large as the run of eels down the river in the fall. The men take their nets which they use for catching eels and will get about as many then as they do in the fall of the year.

Mr. Atkins: It might be interesting to state some further observations I have made on the ascent of the young eels, and it appears to me that they are the most able climbers of all the fishes I have ever known. I have found them frequently at obstructed points in rivers. I remember of the town of Warren in Maine in the river there, I was examining the dam and the mills about it, and there was a large penstock leading to a sawmill, and I walked alongside it, and the water was in the enclosure enclosed with wood—probably twelve feet high—I walked alongside it and the water was oozing out of the cracks near the top and oozing down the planks and boards, and numbers of young eels not more than four inches long, and probably not more than three, were creeping up that perpendicular wall and a great many of them were up higher than I could reach. So I consider them the ablest climbers that we have of all fishes, and it may easily be believed that all the eels in the fresh water came from the sea just as Dr. Gill has said.

Dr. Gill: I expected some dissenting remark, for I know the tendency of mankind to cling to old opinions, but I can assure you and Mr. Atkins that there must be some mistake in

this case, and if Mr. Atkins will only send to the Smithsonian Institution one of those eels we will give the solution of the problem. It is undoubtedly a case of fatty hypertrophy and degeneration of the glands.

Mr. Atkins: What glands?

Dr. Gill: Of the ovaries which are found in rudimentary condition, but also subject to hypertrophy and fatty degeneration, but you do not find the eggs fertile.

Mr. Atkins: I did not maintain that they were fertile.

Dr. Gill: As I said you can find the eggs in a rudimentary condition with the microscope, but those are not eggs that can be fertilized or which will generate young.

Then as for the other conflicting statement that eels do not die after fertilization, I do not know how the gentleman came to that conclusion, because eels are constantly going up and down the river, and why he should suppose that any particular eel he examined had ovaposited I do not know. At any rate it is regarded as certain that eels do die after oviposition.

The ovaries are developed to a great size. The conger eel in ordinary conditions has small ovaries but at maturity sometimes develops them to a bursting condition. Now the eel itself has to go to great depths to spawn, and no eel has yet been obtained from those depths. They undoubtedly will be later, and I am almost surprised that they have not been heretofore, but it is rather a difficult thing to get a large eel from the depth of 500 fathoms or more as you well know, and consequently none has been obtained as yet. But then we have the evidence of these leptocephali that have come to the surface. These leptocephali are found in all conditions; they advance slowly to the land. When they first enter the rivers they are still translucent, but by that time they have assumed the cylindrical form, towards which they have been gradually tending from the time they are found in the high seas hundreds of miles away until they approach the land. Now European ichthyologists, several of them, devoted long years of research to this subject; expeditions have been sent out at a cost of thousands of dollars. These investigators have been well equipped with intellectual and phy-

sical apparatus and have all arrived at the conclusion in question. I think we can rest assured that eels have never developed their organs in fresh water, and that they all die after oviposition.

One more word in proof. Allusion has been made by Mr. Atkins to the fact that eels ascend in numbers up the river. They do ascend in countless myriads. Go to the foot of Niagra at the proper season and you will find them by cartloads, by millions upon millions. Above that there is not one. Now under ordinary circumstances eels can ascend cataracts of considerable height, and therefore they may be found far, quite far from any river in which they have appeared, but when you find them, as has been done, in Lake Erie, it has been by virtue of the fact that they have been transplanted there. They will live there for a long while, for they are hardy and tenacious of life, but they will never propagate.

Mr. Atkins: I did not intend to say that I had observed that the eggs of the eels ever become mature, but only that I saw them in that rudimentary condition, large enough to be distinguished by the microscope, and in immense numbers. I suppose all the time that they went down to the sea so they would mature.

TULLIBEE (*ARGYROSOMUS TULLIBEE RICHARDSON*) AS A FISH OF ECONOMIC IMPORTANCE

BY GEORGE WAGNER.

(Presented by Dr. E. A. Birge of Madison, Wis.)

For several years the State Geological and Natural History Survey of Wisconsin has been engaged in a study of the fishes of the state. Perhaps the chief result of this study so far has been the recognition of the very general distribution of whitefishes of the genera *Coregonus* and *Argyrosomus* through the lakes of the state. The degree of variation among the forms found has proven to be very great, and much more collecting will be necessary before a complete report can be made. It is the intention here to discuss one species, certain peculiarities of its distribution, and their relation to the economic importance of the form.

The Tullibee, or Mongrel Whitefish (*Argyrosomus tullibee* Richardson) is a form chiefly known from Western British America, although recorded from as far east as Lake Onondaga, New York. Occasional specimens have also been taken in all of the great lakes. As far as we know, this is the first notice of its occurrence in Wisconsin, or in any waters of the Mississippi drainage basin. So far we have found the form in three lakes of Wisconsin, which differ rather widely from one another in their physical characteristics. It is now well understood that the critical period for a lake, as far as its living organisms are concerned, occurs in August, at the full establishment of the thermocline. The conditions in these lakes at that time have been well studied by Professor Birge and Mr. Juday of this survey.

The lakes concerned are Kawaquesaga, at Minocqua in Oneida county; North Twin Lake at Hackley; and Long Lake, about four miles east of Hackley. Both of these last are in Vilas county, and all three drain into the Wisconsin river, although by very different routes.

The portion of Kawaquesaga where we took our specimens has been characterized in a recent paper (Trans. Wisconsin Academy of Sciences, Arts, and Letters. Vol. 16; p. 18). It is 12 to 18 meters in depth, of rather irregular outline, and an area of about 2.5 square kilometers. Its surface temperature in August is about 20 degrees C., while the bottom temperature is about 9 degrees C. As we descend the oxygen becomes gradually less until at about 10 or 11 meters it disappears entirely. It was only to corroborate a natural supposition that we fished below this depth and caught nothing. But when we set our nets at 8 to 10 meters, where oxygen still occurs, only in about one-tenth the amount found at the top, we caught Tullibee in abundance and of a weight up to three pounds. From here it ranges upward to within 3 or 4 meters of the surface; at the surface itself it does not seem to appear.

North Twin Lake at Hackley is of about the same depth as Kawaquesaga, but its area is much larger and more fully exposed to the wind. Hence while the surface temperature is about the same as in Kawaquesaga, the temperature at the bottom is higher, or about 11 degrees C. The decrease in oxygen is not quite so rapid either, and there is some left even at the bottom, or one-half m. above it, although only somewhat less than one per cent of what there is at the top. Yet here it is in the lowest meters of water that we caught Tullibee abundantly, and more were taken in shallow water.

Long Lake is of a different character from either of these lakes. It is long and narrow, curved enough so that the effect of the wind is at least partially checked, and of great depth, especially for its width; 26.5 meters were found near the northern third of its length. (It is to be noted that this is not one of the two lakes of the same name, referred to in March's Table of Lakes. Wis. Geol. and Nat. Hist. Survey, Bulletin No. XII; p. 88.) It is fed in largest part by springs and its narrowness from east to west and forested shores protect it somewhat from the warming effect of the sun; vegetation in it is rather scant, except at the lower end, which is shallow. Consequently the usual cause for the consumption of oxygen at the bottom is largely absent, and one-half as much oxygen occurs here as at the top. The bottom temperature is low, only about four or

five degrees C, while the top is nineteen degrees C. Here again we caught Tullibee in great numbers at the maximum depth, and none above, even after repeated efforts.

We have here then a species of whitefish, large enough and of good enough quality as food to be worthy of economic consideration; that seems to be able to adjust itself to quite various conditions of environment. Certainly its adaptability is very much greater than that of *Coregonus labradoricus*, which, so far as our experience goes, occurs only in the deep waters (in summer) of lakes approximating Long Lake in their physical characters. Of course, there is a limit to the adaptability of the Tullibee, as is shown by its restriction to certain depths in both Long Lake and North Twin Lake.

Nevertheless, the species seems to be a very promising form for introduction into certain large shallow lakes. In Lake Pepin on the Mississippi, Lake Winnebago, and some others, we have lakes that are comparatively shallow, and so large that their utilization for commercial fisheries, as well as for sport, is not only possible, but highly desirable. Lake Pepin is now being so utilized to a very large extent. But it yields only the coarser fish, such as buffalo, carp, and to a certain extent, spoonbills. The successful introduction of a whitefish into this lake, and a proper regulation of its capture, would prove a great and lasting benefit. Whitefish (*Coregonus clupeiformis* Mitchell) have indeed been planted in it, but with no success, the genus *Coregonus* being seemingly not adaptable to such waters. But it seems to us highly probable that with so adaptable a form as the Tullibee, and with heavy and persevering planting through four or five years, success could be attained. And there are other lakes in Wisconsin, and probably elsewhere, where it could be introduced and its fishing permitted under certain restrictions, without any detriment whatever to the game fishes.

DISCUSSION.

Dr. Frank N. Clark, Northville, Mich.: I think the recommendation is that the tullibee be planted in these lakes where true whitefish will not succeed.

Dr. Birge: Yes, where there is at least a chance of that.

Q. Has there been any experiment tried in the line of taking the eggs from them?

A. So far as I know there has not. This was a matter discovered only last summer and there has been no opportunity for us to do anything. But it seemed worth while to make the suggestion so that if there was opportunity something might be done.

Q. Then it is not known in just what form the egg may be, but probably something like the herring egg.

Dr. Birge: We shall try if possible to have our fish commission get some eggs next fall. Our species in the inland lakes spawn in the late fall and I would expect the tullibee would spawn much about the same time.

Mr. S. G. Worth, Beaufort, N. C.: I would like to ask in what manner the quantity of oxygen in the water at those different depths was determined.

Dr. Birge: I gave an account of that at the last meeting. The Wisconsin Geological and Natural History Survey has been making an extensve study of the distribution of oxygen in the Wisconsin lakes, and we have been aided by the United States Bureau of Fisheries in that work. We shall make some report on it at the later meetings. Perhaps it would be as well not to go into that at this hour, but the oxygen, temperature and other physical conditions in these lakes were examined carefully from the surface to the bottom, at frequent intervals, as close as one meter apart, wherever there was any essential change. Mr. Wagner was working with us, catching fish in the same lakes as those in which we were determining physical characteristics; and there is no question about the correlation, the work being done within the space of a few days.

EXPERIMENTS IN REARING SMALL-MOUTH BLACK BASS

BY ROBERT RIPPLE, IN CHARGE OF HATCHERY, MINOCQUA, WIS.

(Presented by E. A. Birge, Commissioner of Fisheries.)

The following paper records some experiments made at the Minocqua Hatchery, Wisconsin, with artificial nests for rearing small-mouthed black bass. These nests are made of Portland cement, mixed one part cement, two parts sand, moulded in a box twenty-four inches square, with rounded corners. They are about three inches thick at the edge and one inch thick in the center, where there is a hole one inch in dameter. They weigh about fifty pounds each. The surface is covered with gravel and stones, and sprinkled with sand. About fifteen to eighteen stones of various shapes and the size of hen's eggs are set near the center; outside of these come smaller stones, diminishing to fine gravel at the edge. Great care is exercised in setting the stones, so that the nest will appear natural and so that the nest will drain as well as possible to the central hole. When in use the hole is blocked by a small stone. This prevents loss of eggs in the hole and also makes the nest more acceptable to the fish. A loop of strong copper wire is embedded in each side of the nest, by which it can be easily handled.

The purpose of these nests is two-fold: 1. To render possible some experiments in hatching eggs on trays after removing from the nests. 2. To furnish better conditions for hatching than are given by the nests made by the fish themselves.

I will speak of the second point first. It is well known that no better conditions for hatching the fry can be supplied than are offered by a natural nest of the best type, on which the eggs are properly spread by the female and which is properly guarded and fanned by the male. But such conditions are by no means always met. The stones in the center of the nest may be too large, leaving deep and narrow crevices; and whether they are large or small the spaces may be such that the eggs which fall into them cannot be properly fanned. Such eggs are almost

certain to die and to be attacked by fungus. This condition is aggravated when, as often happens, the female does not properly

BLACK BASS NEST.

scatter her eggs but drops them in masses. In such case those eggs which fall between the stones are certain to become fun-

gused. Many failures of nests to develop fry, attributed to lack of fertilization, are really due to causes of the kind here indicated. The evils caused by imperfect circulation of the water are by no means ended when the eggs are hatched. Many of the young fry fall between the stones and are smothered or attacked by fungus.

These evils have caused annually the loss of many eggs and fry at the Minocqua Hatchery and I was, therefore, led to experiment with the artificial nests described. Some fifty nests were made last winter and were put to use this season. They were placed in the ponds so as to be sheltered by a stump or log and were sheltered by a two-sided frame of one-half inch boards, placed near the nest. The males hesitated at first to accept them but soon did so and altogether some seventy-five pair of bass used them in ponds where there were plenty of old style box, loose gravel nests. In many cases they preferred the new nests; a good many being used more than once. Many of our breeding bass come from lakes where they are accustomed to spawn on bars covered by large stones. Such fish will hunt for spawning beds like those to which they are accustomed; but if they are put into ponds with only sand or fine gravel on the bottom, they will come to the artificial nests and be content with them. They will also hatch out and raise a larger percentage of fry on the artificial nests than on one constructed by the fish out of large stones. Even though only smaller stones are given them, the circulation of water is better in the artificial nest than under natural conditions and the results are correspondingly better. Altogether some fifteen nests were hatched successfully under natural conditions on these cement nests and the results were such as to convince me that it would be well to provide them in all cases.

The immediate purpose of making the cement nests was, however, not so much to furnish the bass with better nests than he could build, but to make possible experiments on removing the eggs and hatching them on trays. When the eggs are first laid they adhere rather firmly to the stones, but after the third day they can easily be detached. The nest is taken from the pond to the hatching house and placed on a tub or similar vessel in the fry trough. The water is allowed to rise in the trough until it fills the tub, and, rising through the hole in the center of

the nest, fills it to the edge, or, at least, so as to cover the eggs. The eggs are then loosened with a feather, working them toward the center; the nest is then raised and lowered a few times and the eggs flow with the water through the hole in the nest into the tub. The whole operation may take a half hour on the first day; two or three days later it would occupy perhaps ten minutes. If the nest has been made with the proper drain and dish, the eggs are removed quickly without loss or injury. They are then placed in trays, which are put into an ordinary hatching trough. Only three trays are placed in each compartment, so that the eggs may have abundance of water; each tray carries about 3,000 eggs. The temperature of the water is 55° to 57° F.

After hatching, the fry remain on the trays until they are ready to feed—about ten or twelve days. They are then transferred to screens in the ponds to feed themselves until they are distributed. About 50,000 fry were raised in this way during the present season with very little loss.

I do not recommend that all eggs be taken from the nests and hatched in this way. The conditions offered by artificial hatching are as good, but not better than the best natural conditions. But every breeder of bass knows that there are many nests in his ponds, where part of the eggs and fry begin to become fungused from the causes indicated in this paper. If such nests are on natural bottom nothing can be done to save the eggs, since they cannot be removed from loose stones, gravel, and sand. But if all the fish spawn on these cement nests, those nests may be left in the care of the male which are in good condition and are properly cared for, and the others can be saved by removing the eggs. The best are not unlikely to be the nests containing the largest number of eggs, and there will probably be a considerable number of nests, so that the gain will be well worth the cost in time and trouble. Many smaller losses of eggs are also avoided by the use of these nests, since in the natural nests it almost always happens that some eggs or fry are deposited where they are not in the currents of water, and die in consequence. Some nests are also deserted by the male fish and are left without the natural protector.

It is intended next season to furnish these nests for all the

small-mouthed black bass in our ponds. A further report will be made if any new or interesting facts develop.

DISCUSSION.

Mr. W. E. Meehan, Harrisburg, Pa.: This paper represents the very latest development in small-mouth bass culture, as far as I know, and it is extremely interesting, and I have another matter in connection with it to which I wish to allude. We have here today a man who may perhaps share with one other man the title of father of the work of bass culture. If I mistake not, somewhere about 1880 a major in the army, I think Major Wright, built a pond, put bass in and hatched them and prepared a bulletin published by the United States Commission in 1881. Almost simultaneously Mr. Hiram Peoples of Pennsylvania, started bass culture near the city of Lancaster, and he is here today, and I think some might be interested in knowing of Mr. Peoples' early work in that line, which seems simultaneous with the work of Major Wright. Mr. Peoples was a member of the Pennsylvania legislature for several years while conducting this hatchery of bass commercially.

Mr. Hiram Peoples, New Providence, Pa.: I have been engaged in bass culture for a number of years, at first, merely as a matter of pleasure, and afterwards in a business way. In constructing my nests I take only good sized stones, none less than the size of a common marble up to the size of a walnut, and larger. I place these nests around my pond, not closer than fifteen feet apart, and in water say from eighteen inches to two feet deep; and I have always succeeded in raising all the bass I needed. In fact I have been able to supply all demands.

I have never taken the spawn right from the nest, but I have taken the small bass immediately after being hatched, and placed them in adjacent ponds, but never had any success. I always had to keep my bass until partly matured.

I never had any trouble with fungus or any disease in the ponds. I can drain my ponds in two days and put fresh water in, but I do not generally do that. I drain every spring and fall.

I ship my bass from the 15th of June till the 10th of August.

If there are any remaining then, I keep them until the fall and then ship them. I have never tried the artificial nests.

I was first led to make the nests as I do by watching the bass themselves. I was pretty fond of fishing, and I would bring fish from the river up and dump them into the pond, and I happened to walk around one day and saw these bass working at the nests; I saw the kind of nests they made and after that I imitated them. I place in a pond of a quarter of an acre, about thirty bass, and I am very careful in selecting them. If you have bass that spawn ten days later than the main lot you will eventually have no bass. Those ten days older will grow and eat all the rest. I remember in my pond I saw a splendid nest and I debated whether to encircle them immediately with fine netting or not; but I did not do it until the second day, and then there were no bass there. The great trouble in raising bass is to keep the small ones from eating one another. In one case I estimated there were 20,000 bass in a certain pond in the spring, which I did not drain until fall, when I had only 260. I put 400 at one time in a trough, and at the end of a month had only four or five left.

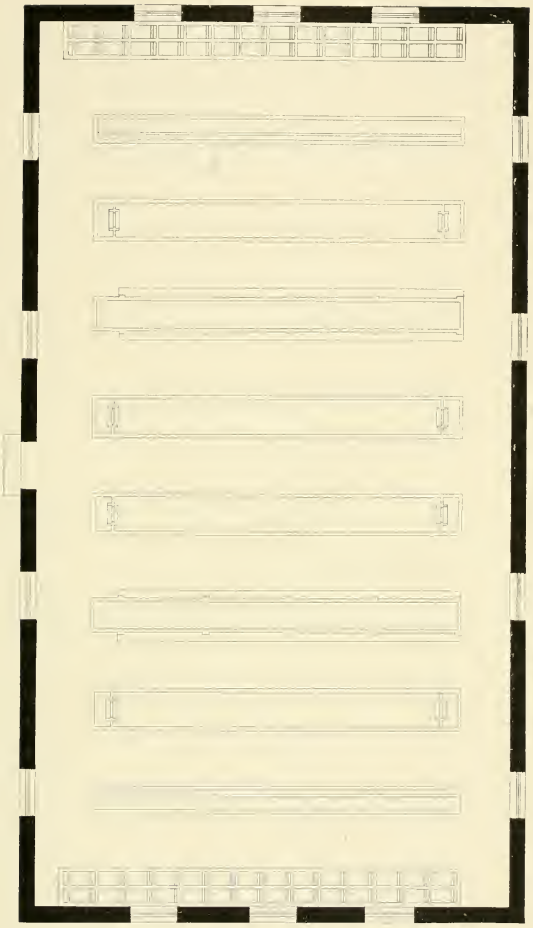
THE MODERN HATCHING HOUSE

BY S. F. FULLERTON, OF ST. PAUL, MINN.

We live in the *beginning* of the cement age; no, I will say that we are living *in* the cement age. They are building almost every kind of plant that can be built with wood, iron, stone or steel and using cement to do it. Today we see stately buildings, immense bridges, great elevators—all constructed of cement. But the purpose of this paper is to show what can be done with cement by the fish culturist. Various materials have been used, wood, perhaps to a greater extent than any other, tin, sheet iron and various compositions but none that gave entire satisfaction; sheet iron and tin for the reason of its elasticity not being stiff enough; wood for the reason that it was short lived and consequently expensve.

A year ago, as superintendent of fisheries for the state of Minnesota, I was confronted with a problem of replacing all the wooden buildings and troughs including our pike-perch battery at our St. Paul station. We had been patching until it was hard to tell where the original left off and the patchwork began. I had constructed some cement ponds four years ago and found they gave good satisfaction, standing the winters and summers, and consequently the contraction and expansion that would come with the heat and cold. I laid my plan before the board and got their approval to build a cement house 32x64, everything but the roof, doors and windows to be cement.

The place selected was a veritable swamp, twelve feet of muck and peat filled with springs. We made up our minds if a building could be constructed of cement on land of this description it would be a pretty good test of what could be done with conditions more favorable. We first laid 4x10 plank side by side lengthwise of the foundation walls, placing six inch cedar posts four feet long crosswise every four feet apart. We then walled up the sides and placed our concrete mixture, consisting of two parts of broken stone, three parts of clean, sharp sand and one part of Atlas Portland cement. This part of the wall



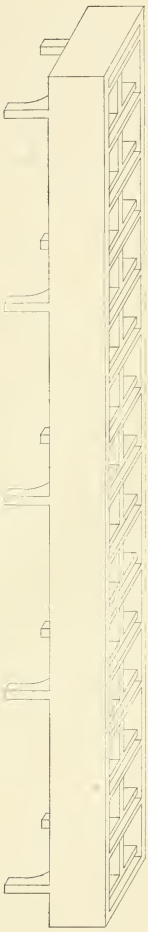
we built two feet high so that we had for a starter a foundation of 2x4 of concrete floating on this peat bog; then we jogged the wall six inches on each side and built another foot. Then the

wall proper was started, being twelve inches thick—that was built of the same mixture and in the same manner to the required height, setting our windows and door frames as we advanced. In the walls we built all pipe connections for our intake and waste water as all water used is gravity. The whole house has settled six and one-half inches and settled all together.

Now the problem of a floor on this bog was next to be tackled. We leveled the ground off fairly well and put a coating of railroad cinders to the thickness of ten inches, using the hose and two men tamping all the time so when the ten inches of cinders were all in we had a fairly hard surface. Then we laid all around the walls a row of three inch tile drain pipe connecting with a pipe already built in the wall. We then laid our waste pipes in the cinders and over the entire surface of the floor we laid ten inches apart 2-inch old gas pipe that we got for $1.50 per hundred from Brother Israel who had picked them up as old iron. Then we put on concrete of the same mixture as the walls to the thickness of four inches. On top of this we put a 2-inch layer of clean, sharp sand, three parts to one of concrete, this finished our floor and not a sign of a crack is visible because it is all bound together and when one part settles the whole surface must go down together.

Now, to utilize this floor space to the best advantage we decided to construct our troughs and batteries across the narrow way of the building. On each end we constructed our frames for a Clark Williamson box for our trout. These we made double, each pocket 10x15x15 deep, fourteen compartments to each side, sixteen trays to each compartment, making a total for the two boxes of eight hundred and ninety-six trays. The walls we made three inches and the cross sections two inches. It took about 680 feet of lumber at $14.00 M, to make the frame for this box. Of course, the sides and bottom can all be used over again, but the wood used in the inner walls must be cut out and is entire waste. We used twenty-two sacks of cement, and of course three times as much sand—about four loads, costing $1.00 per load.

Four feet from this box we constructed our picking trough made to hold the trays as they were taken out and distributed. This picking trough I built with a four inch space for the dead eggs and a pocket on the end to receive them, as I intend to use



the water for a rearing pond at the back and don't want the dead eggs in there. Four feet from the picking trough I built a receiving tank for our pike-perch work, using half inch rods well

painted with ten inch end washers built into the wall of cement. This stiffens it and prevents either contraction when empty or expansion when full of water. Next to this I built our battery four tiers high with connections with the tanks all of cement, so the house holds two double Clark-Williamson boxes, two picking troughs, four receiving tanks and two batteries. In all the cement work I ran a No. 4 soft wire within two inches of top of wall and around the ends so as to have a continuous wire all around; also, in the Clark-Williamson boxes I ran a wire through the cross walls connection with the outer walls, binding the whole in one solid mass. The mixture for the boxes I made after experimenting out of clean, sharp sand three parts to one. I have experimented with six to one, five to one, four to one and two to one. I find the two to one too rich and liable to crack but the three to one in my estimation is the ideal mixture, but we must always be careful to have the cement and sand well mixed and if care is taken there is no question about the durability of the boxes.

All legs under the boxes are part of the boxes themselves and built from the floor up of cement. I scrape all frames on inside, which leaves the cement smooth when boards are removed. Then I thoroughly remove all fine cement dust, filling in any small dents; then give three coats of Elaterite water proof paint, being careful to see that each coat is thoroughly dry before the next is applied.

Now, I claim these troughs I have described are better than can be made from any other material for the reason that wood will decay and iron and steel rust, but cement will be better fifty years from now than it is when first made. It is always clean, never leaks, does not harbour any fungus growth and does not have to be replaced.

Now, as to the cost: The first cost is more than wood but with clear white pine selling at from $38.00 to $50.00 a thousand the difference is not so great, and is all in favor of the cement when the lasting qualities of the material are taken into account. This year we got our Atlas Portland cement for $1.20 per barrel; the sand and gravel we had on our hatchery ground. We did all the work with our own crew, with the exception of two laborers; but I want to be fair and will suppose that every

bit of material including labor, has to be contracted for the first cost above wood is about fifty per cent. A great part of this is for the frames that must be made and as the most of them must be cut away, they, of course, become useless. Receiving tanks for fry and frames for the picking troughs, one can be used for making several. Also all frames for the legs can be used over by bolting them together and when cement is hard unscrew the bolts and they fall apart and can be re-used.

Now, I have written this paper for the purpose of drawing the attention of the members of this association to the use of cement in constructing troughs for hatching fish. I want you to ask questions and I shall answer them to the best of my ability. There is no question in my mind about the superior qualities of cement over all other materials, and I here make this prediction that inside of ten years no other material will be used by the fish culturist in the construction of buildings and troughs.

DISCUSSION.

Mr. Fullerton: I predict that inside of ten years all houses and all troughs in them will be constructed of cement.

Dr. J. A. Henshall, Montana: Do you reinforce any of the work?

Mr. Fullerton: Yes, with a No. 4 soft wire run through the wall and in the cross section. I just hook it in the long wire; I do the same with the receiving tank.

Mr. Frank N. Clark, Northville, Mich.: I would like to ask if this house has just been built?

Mr. Fullerton: No, it has been built two years.

Q. It has gone through one fall?

A. Yes.

Q. I understand your building is 32 by 64; 30 by 60 inside?

A. Yes.

Q. What is the capacity of your house?

A. We aim to put 2,000,000 trout eggs in the house. I have a pike-perch battery in there also.

Q. One battery?

A. Two.

Q. How are you going to take care of 50,000,000 lake trout eggs?

A. We do not hatch any lake trout at all. This house is designed for Minnesota.

Q. I understand each cross section is two inches?

A. Yes.

Q. That takes up a great deal of space?

A. Yes.

Q. How many trays do you have?

A. Over 800.

Q. Well, with a hatchery where you require large capacity you must build a much larger house?

A. Yes, or build two.

Q. Or three perhaps?

A. Yes.

Q. You state that your room is just about the size of our room at Northville, and our capacity now has been increased 4,000,000. We had 46,000,000, and it is practically 50,000,000 capacity now. You have just about the floor space that we have now, and it holds 50,000,000. Of course with your plan of cementing it could not be done.

Mr. Fullerton: Why?

Mr. Clark: There is not room enough in the house. Where you have 400 trays, we have about a thousand in the same floor space.

Mr. Fullerton: But you have got more boxes.

Mr. Clark: I say where you have 400 and odd we have over a thousand.

Mr. Fullerton: We could increase the number of our boxes.

Mr. Clark: No, you cannot, not with your cement.

Mr. Fullerton: Why?

Mr. Clark: Your cement takes up so much room.

Mr. Fullerton: Not a bit—only two inches more than yours does.

Mr. Clark: You have two inches each side.

Mr. Fullerton: No, one inch on each side more than yours.

Mr. Clark: The question is whether we cannot devise some means of making that cross section a great deal narrower—that is what I am getting at—instead of having it two inches, get it down to an inch by using wire for reinforcement so that we will not have such a bungling trough and it will give us more capacity. I am just getting ready to put in two new pigging troughs and with the approval of the Washington office I shall undertake to put in cement.

Mr. Fullerton: You will never regret it.

Mr. Clark: We have a cement floor in the house and can start with that to build upon.

I would like to ask why iron standards would not be just as good as cement. We have had iron pipes at Northville, without a particle of wood on the floor, for fourteen years; and it is a question in my mind whether the gas pipe as standards would not last about as long, keeping them properly painted—say five years. Ours at the end of fourteen years are just as good as new, and it seems to me it would be easier to have the iron standards than the cement standard as a support.

Mr. Fullerton: Perhaps iron would do. I do not see why it would not. I started out to make a cement trough throughout altogether, and we made the legs circular and four inches square on the floor.

Mr. C. G. Atkins, East Orland, Me.: How long after you completed these troughs was it before you put eggs or fish in them?

Mr. Fullerton: I do not know just how long—some months.

Q. Did you ever see any difficulty that appeared to come from the cement injuring the water in any way?

A. No, the paint would stop that anyway.

Mr. Atkins: I have heard some objection made on that ground.

Mr. Fullerton: I believe that soon we will all be using cement.

Mr. Clark: You can put water in in twenty-four hours.

Mr. Fullerton: Yes, in six hours.

Mr. W. H. Safford, Conneaut Lake, Pa.: How many rows of troughs have you in your perch battery?

A. Four, one above the other.

Q. And your jar standards—what provision have you made for those?

A. I am glad you mentioned that. We have here a continual shelf for the jars to set on, and through that shelf there is a pipe.

Mr. Safford: Did you give any estimate of about what the weight is for each trough and about how many troughs that floor would stand? For instance, at my hatchery in Crawford county the water supply is limited, and in order to get at a production that we think the hatchery is capable of putting out, we get our increase in the number of troughs. I have eight, one above another in my battery, and in that way it gives us343 jars in one battery.

Q. That is, on both sides of the battery, is it?

Mr. Safford: Yes. Do you suppose that the first trough in your battery would hold up, say eight of those?

A. Yes, I think it would hold up twenty or thirty. These standards are all made of cement right from the floor.

Q. What are the dimensions of the standards?

A. Four by four. The shelves that the jars set on are cement, built into the standards; it is all one solid piece of cement.

Q. Do you make these troughs separately or build them all together?

A. We build them right in there.

President: This is a paper of unusual value and is broad enough to cover the general cement work.

Mr. Clark: I do not want to advertise myself nor the Clark-Williamson box—the only box I ever got up; but I will say for the benefit of the members here that the box known as the Clark

box was invented by my father in 1874. As Mr. Fullerton has told you, this is the Williamson box, and the Clark-Williamson box is really a combination of the Clark box and the Williamson. Now in the Clark-Williamson box (as I showed you with a model at White Sulphur Springs) is an opening where the water comes up through a two-inch water space and flows over on the trays. Now the Clark-Williamson box is simply widened out, and we use it for trays and it has a remarkably great capacity in comparison with the space occupied.

Now I would suggest, if you build trough that to save expense and economize space, you try a Clark-Williamson box.

John W. Titcomb, Washington, D. C.: All the parts of the equipment exhibited at the White Sulphur Springs meeting are on exhibition in our basement at the Bureau of Fisheries. We also have some salmon eggs hatching there. Part of this equipment is in the main exhibition room and labeled, and a part of it is out in the car shed, and there you can see the Clark box and the Clark-Williamson box illustrated.

Mr. Fullerton: One word about Mr. Clark's statement as to capacity: We can build these troughs two feet higher if we want to and increase the tray capacity.

Mr. W. T. Thompson, Leadville, Colo.: How many trays will yours hold?

Mr. Fullerton: Sixteen, one on top of another.

Mr. Clark: We are now building double deckers. I think the next one I build will be a three decker.

Mr. Fullerton: There is no limit to the number you can build and the cement is all right.

SOME EXPERIMENTS ON THE ARTIFICIAL EXPRESSION AND FERTILIZATION OF GOLD FISH

BY JERRY R. BERKHOUSE, SUPERINTENDENT OF THE PENNSYLVANIA STATE FISH HATCHERY, TORRESDALE, PHILADELPHIA.

The Department of Fisheries of the Commonwealth of Pennsylvania rears gold fish for the use of public schools, public institutions and public parks, but not for private applicants. At the hatchery under my charge at Torresdale, Philadelphia, I handle principally the common gold fish and to a limited extent, Japanese three tails. From autumn until early spring the adult gold fish of both types are kept in a large triangular pond and in the spring the three-tailed fish are removed to a smaller pond. The regular practice has been to have the gold fish of both types deposit their eggs on the roots of water hyacinth, the plants containing eggs being removed every morning to small ponds having no fish of any sort, and the eggs allowed to hatch naturally.

During the winter of 1907, my chief, Commissioner Meehan, directed that when the spawning period arrived I should make some experiments in the artificial expression and fertilization and hatching of gold fish eggs. This I did in the latter part of May and beginning of June, 1908, being perfectly successful in artificially taking the eggs and fertilizing them and succeeding in hatching more than 60 per cent. I used three females of the common gold fish and a like number of males I pressed the eggs from the female and the milt from the male in precisely the same manner as from a brook trout. Both the eggs and the milt flowed with perfect freedom, just as freely in fact as eggs and milt from brook trout.

Before taking my first fish I dipped the pan in the water, but instead of draining it off as is usual in the dry method, I left a small quantity of water on the bottom, just enough to cover it but not enough to bury the eggs. After taking the eggs,

I pressed every particle of milt obtainable over them and it was a very large quantity, so much that the water in the pan was distinctly whitened. After fertilization the eggs were washed and allowed to harden, as I would do in a case of brook trout eggs, but in a few minutes they matted together in a thick mass even more compactly than the eggs of the wall-eyed pike would under the same circumstances. I separated them as well as I could in the same fashion as I would the eggs of the wall-eyed pike, but even then there were a number of nodules or balls of several eggs. I then transferred them to a hatching jar and turned on the water. Although the faucet was turned so slowly that the water merely dribbled through and carried air with it into the tubes, the current thus created was sufficient to cause many of the eggs to rise to the surface, and had it not been for a screen of cheese cloth across the lip would have escaped into the trough. The eggs also when they touched each other immediately clung into little balls. None of these eggs hatched. Practically all the eggs died.

The eggs from the second fish were taken by the dry method and after fertilization and the introduction of water, I added a small quantity of mud and worked the eggs in the same manner as wall-eyed pike eggs used to be worked under the same circumstances. After washing, having previously prepared a hatching trough by running about eight inches of water therein, I poured the eggs over a cheese cloth tray scattering them so that they scarcely touched each other. I allowed the tray to float on the surface covering the trough with a board so as to totally exclude the light.

The amount of water flowed through the trough was little more than dribbling. The stream was scarcely larger than a knitting needle. In five days with the water temperature at 50, about 60 per cent of the eggs hatched.

The eggs from the third fish were taken and handled in the same manner as the second, but instead of putting them on a tray, I allowed them to sink in a trough upon some fine gravel which I had placed there. The depth of water was the same as in the case of the eggs of the second fish, namely, eight inches. The eggs settled very slowly, so slowly in fact that at the end of half an hour those which were still not on the bottom I scooped

up and placed upon a cheese cloth tray allowing the tray to float on the surface as before. Every egg that sunk to the bottom died, while the hatch of the eggs on the tray was the same as the eggs from the second fish, namely, sixty per cent.

From this and from other circumstances when the eggs are naturally deposited I believe that gold fish eggs must be hatched either immediately below the surface or not more than three inches. The adhesive character of the gold fish eggs is very pronounced. Any eggs placed upon a tray glued themselves fast to the cheese cloth and they could not be moved by any oscillation of the tray and in three cases out of four attempts to pick the eggs resulted in breaking the shell. Not one of the six gold fish, male and female, handled died and none seemed to be affected in the slightest degree by the handling.

DISCUSSION.

Mr. J. W. Titcomb, Washington, D. C.: I think that is very interesting and a novelty. I hope Mr. Berkhouse will continue the experiments, and trust that he will meet with better results.

THE MUSKALONGE OF THE OHIO BASIN

BY HON. TARLETON H. BEAN, OF ALBANY, N. Y.

This species was first described in 1854 by Dr. Kirtland from a specimen taken in the Mahoning river, Ohio; it was known, however, much earlier (1818) to Rafinesque, who stated that it reaches a length of five feet.

The barred muskalonge is found in Lakes Conneaut and Le Boeuf, in Pennsylvania. In August, 1902, Mr. F. J. King, of Waterford, Pa., caught an individual measuring four feet seven inches and weighing forty-four pounds two ounces. Lake Le Boeuf empties into French Creek, a tributary of the Alleghany river. In this lake the muskalonge frequents weedy bars around the entire lake and a smaller bar running through the middle.

During the investigations conducted by Prof. W. P. Hay for the United States Bureau of Fisheries in 1899 and 1900, a muskalonge eight inches long was obtained from Deckers Creek, above Morgantown, West Virginia. This is recorded in the bulletin of the bureau, Vol. XXVII, 1907, p. 37.

This muskalonge is a beautiful fish, and excellent for food. Its color is olive green with golden tints, and with a wonderful irridescense which the artist has expressed most happily in his drawing. On the sides are from twenty to twenty-three irregular, dark, crossbands, with some intervening partial bands and blotches. The lower third of the breast fin is pink. The tail fin and anal show dark blotches forming pseudo bands. The iris is lemon yellow on a white silvery ground, or sometimes, in smaller individuals, almost vermilion and orange. There is a dark blotch at the upper edge of the gill cover. There are no roundish black spots, so characteristic of the St. Lawrence river muskalonge.

Those who may desire to compare measurements of the Chautauqua form with those taken from muskalonge of the St. Lawrence river or great lake region will find tables in bulletin 60 of the New York State Museum, Catalogue of the Fishes of New York, page 305. It must be said, however, that the meas-

urements aid little in distinguishing the two races, and if northern individuals are barred like the Ohio basin form, it will be necessary to revise our ideas about distribution at last. The muskalonge in Chautauqua Lake has been known to reach a weight of fifty pounds, and it is justly regarded as one of the best food fishes of those waters. In the spring of 1895, when eggs were being collected for the Bemus Point Hatchery, it was not unusual to take individuals weighing from forty to fifty pounds, and many fish ranging from twenty to thirty pounds were captured.

When the lake becomes very clear, in February, the fish go into deep water, and they live in deep water more or less all the year. In winter, they frequent nearly the same localities as in summer, usually in the vicinity of water plants.

For fish culture operations pound nets are set at a number of places near Bemus Point as soon as the ice leaves the lake. The fish begin to spawn a few days after the ice is out and continue until the latter part of April. They spawn in comparatively shallow water, ten to fifteen feet deep or less. A few eggs were found in the stomach of a catfish near the mouth of a creek where the water was only five or six feet deep, and they were so recently swallowed that they were uninjured, and some of them were afterwards developed in the hatchery.

The muskalonge does not resort to the gravelly bottoms, like many other fish, but to mud, usually going into bays.

The males are smaller than the females and very little milt suffices to fertilize a large number of eggs. A female weighing thirty-five pounds yielded 255,000 ripe eggs. The eggs are about one-eleventh of an inch in diameter, and 74,000 fill a quart measure. They are semi-buoyant and non-adhesive, like whitefish eggs. Under favorable circumstances about ninety-seven per cent of the impregnated eggs have been hatched. In the early experiments with artificial culture some eggs were hatched in fifteen days with a water temperature of fifty-five degrees Fahrenheit. The fry when first hatched are very small and quite helpless. The yolk sac is absorbed in about fifteen days in water at fifty-five degrees.

According to E. W. Irwin, of Mayville, N. Y., he was the first to suggest a hatchery for muskalonge at Bemus Point. He

states that Seth Green sent Jonathan Mason to his house in May, 1887, and the first attempt was made but failed as the fish had finished spawning. In 1888 Mr. Mason renewed the experiment and, with the help of Frank Cheney, he collected and hatched eggs of the Chautauqua muskalonge artificially for the first time.

The eggs were hatched in a box with wire top and bottom, suspended about four feet from the bottom in eighteen feet of water. Since that time eggs have been developed in boxes placed in a small pond formed in the little creek which flows through the hatchery grounds. At the present time the eggs are placed in glass jars and hatched like whitefish eggs in artesian water with a uniform temperature of about forty-eight degrees. The embryos are too heavy to swim out of the jars, and, therefore, they are transferred at the proper stage of development to trays in boxes placed in the hatchery troughs. These boxes are fitted with wire at each end, to insure a direct and uninterrupted flow of water, which prevents the banking up of the fry at the lower end of the tray.

In 1906 the egg-taking season on Chautauqua Lake began April 18, and on April 30 Foreman Brown reported that the fish were about done spawning below Bemus Point, but were nicely started up the lake. A snow storm in late April delayed the spawning. On May 7 Mr. Brown reported that 7,000,000 eggs were in the hatchery. On May 16 one jar of eggs commenced to hatch. The shell of the egg was very dark—almost black. Premature hatching occurred in some cases, very likely on account of the difference in temperature between the lake water and the water of the artesian well, a difference amounting to seven or eight degrees. When eggs carried in the lake water were placed in the jars at the hatchery during such a difference of temperature many of them hatched prematurely.

He finds the cold water very bad for hatching muskalonge eggs. They do not develop properly. Some of them have no shell when they hatch. The fry are small and weak. They never used to hatch that way in warmer water; the fry would be black and strong, and almost twice as large. It is against nature to hatch the eggs in cold water; the water should gradually grow warmer. Lake water is the best for them.

June 1, Mr. Brown wrote that in handling the eggs the poor ones will burst; they all bunch and stick together; it is impossible to do anything with some of them.

Mr. William Buller, of Corry, Pa., has hatched muskalonge eggs on the finest trout trays in water at a temperature of forty-five degrees. He stated that the hatching period was sixty-two days, and that the fry obtained were fine and healthy.

Excess of air in the artesian well water at Bemus Point, May 27, 1907, made it impossible to keep the eggs in the hatching jars. Mr. Brown was advised to transfer them to boxes in the little creek in hatchery grounds, or to run them in the fry boxes in the hatchery troughs.

He was afraid to transfer the eggs from cold to warmer water and, furthermore, the eggs were so tender it would not do to handle them. Air bubbles do not come on the eggs until they are about ready to hatch and as soon as they hatch the bubbles collect on the fry. Fry eggs, good and bad, all run out together into the pond. He collected them in the pond and put them back in jars. It is a bad mess. The fry do not carry very well in the troughs. Eight boxes (or 80,000) were lost and there was no apparent cause for their dying.

On June 7 I suggested to Mr. Brown that he might flow the water a long distance before allowing it to enter the jars and troughs. Or he might rig up a wooden trough or flume, open at the top so as to increase the distance between the point of delivery and the eggs or fry to be handled. The best way out of the difficulty, as long as artesian water is used, would be to receive the supply into a big pond or box and let it pass into another box before entering the hatchery. A fine screen placed in the course of the flow will help to break up the air bubbles. But the proper solution of the trouble would be to pump water from the lake in much larger quantity than is available at present.

If we continue to use artesian water, another well should be put down and it should be run into a large reservoir before coming into the hatchery. Mr. Brown cannot see why there should be so much air this spring (1907); there was very little in the spring of 1906. In some cases the fry would not carry well in troughs; they would be all right for about four or five days and then begin to die. The loss in this way was between 150,000

and 200,000. The last shipment of fry was made June 17 and there were a few more to be planted in Chautauqua Lake. Mr. Brown did not attempt to rear any in 1907.

The muskalonge kept in a small creek in the hatchery grounds at Bemus Point grew faster than those in the artesian water in the hatchery troughs and ponds. The artesian water apparently lacks something which the young fish require.

Muskalonge fry can be kept very easily until they begin to swim up, but after that period the losses through cannibalism are so serious that it has been found impossible to rear them either at Bemus Point or at Gorry, to which latter station some of the eggs and fry from Bemus Point were shipped in exchange. On June 28, 1907, Foreman Brown was still holding 100,000 of the fry at Bemus Point. On May 30 80,000 of the fry were taken to Corry, Pa., in two rather small cans. The shipment was successful, notwithstanding the crowded condition of the fry and the high temperature of the air.

The embryo muskalonge does not swim up as soon as the young of most other fishes, and it is much affected by the quality of the egg. Sudden changes of temperature of the water injure the egg very seriously. The lake water warms up very rapidly during the egg taking season so that a difference of seven or eight degrees is often observed when the eggs are transferred from lake water to hatchery water. This seems to account for the rather small percentage of fry obtained from eggs —a percentage sometimes not exceeding sixty degrees. The best water for developing this species is, undoubtedly, the lake water which could be introduced by pumping. Incidentally this would be the means of increasing the capacity of the Bemus Point station to any desired limit.

Many attempts have been made to rear the muskalonge to fingerling size, but none have succeeded on account of the cannibalism so characteristic of the young. The fry are liberated as soon as they are able to swim freely, and most of the product of the hatchery is placed in Chautauqua Lake. The young fry are usually ready for planting about the end of May, or in June.

The best illustration of this muskalonge is the color plate by Louis Rhead in the report of the New York Forest, Fish and Game Commission for 1904-1906, recently published. The study

was made from an example caught by the artist in Chautauqua Lake in the fall of 1906. A black and white picture, adapted from the original drawing, was used by *Forest and Stream* on its cover page November 3, 1906. Mr. Rhead's account of his experience in fishing for this species, published in *Forest and Stream* of the date mentioned, contains interesting facts about its feeding habits and its actions when hooked. He considers this fish the best of its race from every point of view.

Mr. Rhead found that live or artificial minnows are not taken until fall, and that spoons of different shapes and sizes are used successfully in the early part of the season. His first success came on a luminous tandem, smaller than muskalonge spoons, and a good lure, close, compact, and the triangle hook well covered with feathers. At the suggestion of R. R. Brown in charge of the hatchery at Bemus Point, he tried a spoon made by a local expert angler, and found it so meritorious that other lurers were scarcely used. The spoon is made of brass, copper, steel and gold. Instead of the customary triangle, it has a powerful double hook, curving downward and ingeniously covered with bucktail, a red feather on each side, and just a touch of peacock's feather to give brightness.

The mode of fishing practiced by local anglers and guides is to troll with rods placed in sockets on each side of the boat, and two hand-lines worked closer in toward the boat, so that four spoons at varying distances require attention nearly all the time. Working as they do toward and in the weeds, better success is likely to ensue, though added trouble is caused by reason of snags. In trolling, a noiseless boat is necessary, and even and regular rowing. One trip over a strip of water is no criterion of its possibilities. A day's patient fishing in one place is surest, for the muskalonge is a swiftly moving fish.

Muskalonge have been taken that were literally crammed with fishes of various sizes and kinds, showing they were not hungry. The number of fish swallowed during a single summer is almost incredible. They are not minnows and small fry only, but large enough to reproduce their kind. In rowing over Chautauqua Lake Mr. Rhead saw many good-sized fish floating on the surface, not yet dead, with great gashes and pieces of flesh

torn off, telling of slaughter among the smaller fishes, which are constantly leaping from the water in terror of this formidable foe.

SOME REASONS FOR FAILURE OF FISH PROTECTIVE LEGISLATION AND SOME SUGGESTIVE REMEDIES

BY OREGON MILTON DENNIS, FORMER STATE GAME WARDEN OF MARYLAND, OF BALTIMORE, MD.

In speaking of the subject of "Some Reasons for Failure of Fish Protective Legislation and Some Suggestive Remedies," I want it distinctly understood in the beginning, that, while my language may appear to be harsh and my criticism severe with reference to some causes for the failure of the passage of proper and effective fish protective legislation, I am dealing with this subject in generalities, and without particular reference to any person or protective association.

I have come to the conclusions which follow, after very careful deliberations, and shall deal with it as I have with every other matter with which I have had to do,—in an honest and fearless manner—my sole purpose being to aid in fish protection, and pointing to some of the reasons why it has failed.

A long experience as secretary and council of a large protective association, and as the state game warden of Maryland, as well as a legislative experience, has, I believe, fully qualified me to express some opinions on the subject matter of this paper. Of course, this experience has been gained in my own state, and what I shall say will deal largely with the conditions in that state, a state having the richest bodies of water, commercially, in this country.

The political division of Maryland in the representation in the legislature, through its county members, places the control of legislation within the power of the countries, notwithstanding the fact that while more than one-half of the population is centered in Baltimore City, the latter only has about one-fourth of the delegates. I mention this because very largely protective influences originate in the city of Baltimore, and its chief protective association is there, composed of men who, whether intelligently or not, frame the bills that are presented to the legisla-

ture for its action. I say intelligently, because while its membership represents some of the wealthiest and best of our citizens, its enthusiasm for protection of both game and fish and the bills framed is largely based on selfish reasons as sportsmen, and largely without regard to intelligent conclusions with reference to the right of the commercial fisherman, the vote of which class is sufficiently large in tidewater sections of our state to control the electorate. This being true, the county members of the legislature, as well as the fishermen themselves, look with suspicion upon any and all measures presented to the legislature, which have for their purpose the protection of fish and game when such measures are presented by city men. Growing out of this condition about two years ago a Fishermen's Protective Association was formed in Maryland for the distinct purpose of fighting the city association, whose only interest, they believed, in protection was, to secure to the angler a good day's fishing without regard to his, the commercial fisherman's interest. This condition grew out of a policy of the Game Protective Association introducing measures abolishing the use of all sorts of nets, or so restricting their use, that the commercial fisherman would be put out of business. I am happy to say, however, that during the past year as state warden, I believe that largely through my own efforts both the associations at the last session of the legislature, united on a number of measures for fish protection, but, even with this combination, we failed in specific results.

Unfortunately, in my judgment, the selfish interest of one class and the suspicions of another, is largely the reason for the failure of proper fish protective legislation. The angler goes to the legislature with a bill based on his idea what the law should be—and that idea is usually the prohibition of the use of all sorts of nets which will interfere with his sport; another class of commercial fishermen prepare a bill to protect them in the use of the sort of nets that he fishes with, and still another set of fishermen with a bill to protect him in his method. The result is, that the legislative committee before whom these bills go, are pulled and hauled and besieged and worked upon by the various interests to such an extent, that the committee becomes disgusted and pigeon-holes all the bills, and none are passed.

Another reason is, that while the state of Maryland spends

thousands of dollars for fish culture, it persistently refuses to make any appropriation or to give the State Warden Department any material assistance in the enforcement of such laws as we now have, and while the state navy is charged by law to enforce the laws for fish protection, the character of their boats prevents them from going into shallow waters to do any work, even if it could take the time to divert the boats from oyster protection to do this.

What I have said above is but the foundation for specific reasons which I shall give for failure of protective legislation, and in my opinion can be reduced to the following, to-wit:

First—Up to this time, it is absolutely impossible to get the tidewater fishermen to agree on any bills; in my judgment, even if proper laws were enacted under the system in our state, they would absolutely fail of enforcement.

Second—I declare next to the above reason that the greatest reason for non-passage of fish protective bills, is the action and influence of the duck gunners of Maryland. This class of sportsmen either by purchase or lease, secure absolute control of water fronts in the tidewater counties for their ducking clubs and shooting grounds. These gentlemen, among the foremost citizens of our state, are largely residents of the city, and are jealous of the rights that they claim they have paid for, and in order that they may preserve them, are in constant conflict with the resident fishermen who ply their industry in the waters fronting on, or adjacent to, their shores. Being, as a rule, men of wealth and influence, there is small opportunity to prevail against that influence with the legislators, when there is a conflict between the rights of the duckers and the fishermen.

There are a number of other reasons which, in my opinion, prevent the passage of proper fish protective laws, but these are sufficient for any purpose.

Now as to the remedy. I shall offer but one, but I think this will be sufficiently radical to bring down on my head all the knocks that I can stand up under.

You will remember that I made this suggestion at the last annual meeting of this society: "Admitting the necessity of protection of young fish after being placed in the waters by the states and the United States, the question that confronts us is,

how? I believe that if it comes within the constitutional powers of the government, congress should pass proper interstate laws for the protection of fish."

Thousands of dollars are being spent, practically wasted for fish propagation in Maryland. The state has persistently neglected to provide for protection. Not until after fifty years of constant agitation, and the practical extermination, commercially, of the oyster, has Maryland awakened, (and that but two years ago) to the fact that the oyster in Maryland must be protected or exterminated. If it has taken us this long to awaken to the serious condition of the oyster, how long will it take to recognize the necessity of the protection of the fish, and thus save to the people of our own state and other communities from extermination, one of the greatest natural food products of the world?

Mr. Bryan, at the conference on national resources, in Washington, in May last, in which the governors of the states and prominent men of the nation took part, said with reference to the protection of the great national resources of the country that "he regarded the development of water transportation as essentially a national product, because the water courses run by and through many states." In my judgment, it is just as important for the national government to protect the natural industry which has its life and being as a food product in and under the waters of this country, as it is to enlarge and protect the waterways for carrying away from, and bringing to us, the great commerce of the world. I believe it more important because the product of the water since the beginning of the world, has provided food and life to man long before he thought of the creation of great fortunes by the use of water courses for commercial purposes.

I am a state's rights man, and am jealous of any action of the national government which would deprive the state of a single right, but when you consider that the great bodies of water which produce natural food run by and through different states; when you consider that petty political influences, jealousies, and other equally silly reasons, prevent a state from protecting from extermination a natural product of food, notwithstanding it has legally determined that fish are the property of the state, I am con-

vinced that the only solution of this question is, that the natural control of the fish should be in the federal government, and I hope this society will put itself on record to that end, for I believe that not until this is done, and the federal government legislates for fish protection, and supplies its powerful backing to the enforcement of these laws, will the question of fish protection be solved.

SOME PECULIARITIES IN SPAWNING HABITS OF LARGE-MOUTH BLACK BASS

BY J. J. STRANAHAN, OF BULLOCHVILLE, GA.

Do fish spawn more than once a year? This is the usual way that the layman puts the question to the fish culturist and the answer is in ninety-nine cases out of one hundred in the negative. This would have been my answer nine years ago, or prior to my residence in the south. Of course we all know that carp and some other fishes of that family lay their eggs a few a day over a considerable period of time, but that is not the real question as applying to the more common fishes reared in confinement, such as the basses and other members of the *Centrarchioae* family.

I know of no place where the habits of fishes can be so well observed as at the Cold Spring Station of the United States Bureau of Fisheries at Bullochville, Ga. The water is extremely clear and most of the ponds are comparatively free from aquatic growth. The smaller ones are so restricted in area that observations can be made of all parts of the ponds in favorable weather. The writer has kept careful watch over the spawning operations of the large-mouth bass during the nine seasons during which time he has been in charge of this station, although the larger size of the ponds and the growth of aquatic plants made this work less satisfactory after the first two or three years. However, it is known as an absolute certainty that the large-mouth bass at this station spawn several times a season, extending over a period from early in March to the last of July, and usually in small numbers into August. In fact, we had one case where a male bass had a brood of fry numbering several thousand about an inch long on October 11. Fortunately, Hon. George M. Bowers, commissioner of fisheries, was present and saw this sporadic hatch.

There are generally individuals with distinguishing marks which permits us to identify them in these duplicate hatchings so that there is not a shadow of doubt as to the accuracy of these

statements, but as a further proof I make the following extracts from the annual report of the Cold Spring Station made July 1, 1900, and I would state in this connection that the opportunities were better then for close and accurate observation than during any year since, the ponds being few in number, small in size and almost devoid of vegetable growth. The work was carried out with all the care possible, Mr. J. B. Lamkin, fish culturist of the station at the time, being very methodical and assisting materially in the work, having specially in charge the work of recording the observations which he was instructed to make daily or hourly if necessary:

A few bass had spawned before the writer arrived, eight beds having been recorded prior to that time. Up to the 8th of May no very systematic record was kept as to the location and date of beds, but on that date an order was issued that all beds on which eggs could be found be numbered and marked with a strip of wood on which was to be placed the date and any other necessary data. Prior to May 8 twenty-four beds were located and recorded and after that date up to the 1st of July twenty-five beds on which eggs were found were numbered and dated, thus making a total of forty-nine beds on which it was positively known that eggs had been deposited.

There were but twenty-eight breeding bass on the station, all told, male and female. More than that we have two females which are much larger than any other fish in the ponds, weighing about six pounds each. These fish have spawned several times during the season.

There is another interesting feature in this connection. There is a male in one of these ponds which is conspicuously distinguishable from all the other fish because of having two splits in his tail, one of them extending back to the flesh. The employes of the station call this fish "Old Split Tail," because of this marked characteristic. No other fish is so marked and he is the largest male bass that has been observed caring for a nest. Since accurate numbering has been practiced this fish has fathered seven distinct lots of eggs on six beds. When the fry of the sixth lot were just large enough to raise from the bed a female came along which was ready to deposit her eggs. Being of an accommodating turn, he took her in, fertilized her eggs and

cared for them at the same time that he cared for the former brood, rounding them up and keeping them near the nest and finally bring out brood No. 2. He is a remarkably good father, there being as much difference in this respect with the bass as with fowls.

The third and fourth lots fathered by this fish were abortive, all eggs dying on the nest, he leaving them as soon as they had turned white. I believe that this is the rule, although I would want further chance for observation before announcing this as a settled fact. Eleven beds of eggs were thus abortive at this station this season, or at least appeared to be so. However, there were three of them which hatched a small percentage of fry and in these cases the male remained on the nest until the fry raised and moved away.

If I may be allowed a digression I would state that in examining this report I find a feature which may interest the fish culturists present, namely, that in water of a temperature ranging from 71 to 75 F. the large-mouth bass egg hatches in forty-eight hours and that the fry raise from the bed in from five to ten days, according to temperature, eight days being about the average. Eggs were taken from the beds as soon as deposited and at regular intervals. The embryo could be distinctly seen under the microscope and began to move and change position in the egg in twenty-four hours. When first hatched there was but little color on the eye and no pigment cells were discernable; red corpuscles clear as were all tissues; heart action distinct; single oil drop, lemon yellow in color. In twenty-four hours red corpuscles, amber color, eye almost black and pigment cells showing distinctly. Development from this on was very rapid.

HAWAIIAN "FISHERY RIGHTS"

BY JOHN N. COBB, AGENT UNITED STATES BUREAU OF FISHERIES.

Undoubtedly the most peculiar feature of the fisheries of Hawaii at the time of annexation was the well-established principle of private ownership in the fishes found in the bays and open sea in the vicinity of the shore, also in certain of the streams.

In order to understand these peculiar "rights" it is necessary to refer to the early days of the Hawaiian nation and trace briefly the evolution of its land customs and laws, with which these "rights" are closely interwoven.

Up to the year 1839 all the land of the kingdom was owned by the king, who, by his mere word could give or take away a piece of property. He was also supposed to own the land and water extending out to the reef, or, where there was no reef, for one geographical mile from the shore. Necessarily as he owned the waters and the land under the waters within these limits he also owned what the waters contained, and hence had the right to grant such to whomsoever he pleased. The bill of rights promulgated by the king in 1839 established the right of private ownership in land, and as a result all the powers which he had formerly exercised over these lands fell into the hands of the persons then owning them, the king retaining only his rights over what were termed Crown lands.

Nearly all of the available agricultural land is in the vicinity of the sea or its bays and tributaries. For convenience each island was divided into districts called "moku," and these were subdivided into "ahupuaas," which is the unit of lands in the islands. The "ahupuaas" are generally long, narrow trips, running from the mountain to the sea, and include the mountain, the plateau, and the shore. These great portions of land usually had attached to them ocean "fishing rights," in some instances not only adjacent to their own shores, but spreading out on each side up and down the rocky coast for miles, till they joined another monopoly of the deep-sea fisheries. In a few instances these "fishery rights" did not abut at all upon the land to which

they belonged, the latter being located in the mountains or on the plateau and not reaching to the shore, while in several instances the bounds of the fishery did not reach the mainland at any point. The fisheries attached to these "ahupuaas" generally extended to the reef, or, if there was no reef, for one geographical mile out to sea from the depth where a man could wade; some of the "ahupuaas" were granted by metes and bounds one mile and a half out to sea.

The "ahupuaas" were further subdivided into "kuleanas," which were small plots of land granted to the retainers of the "konohiki," or landlord, who controlled the "ahupuaa." The "kuleana" carried only the right to fish from where a man could wade up to about five feet.

On the island of Kauai exclusive "fishery rights" covering the rivers were also granted. There were two such "rights" on Hanalei river, and one each on Nukuhuliia, Lawai, Hanapepe (running up both banks as far as the tide extended), and Huleia rivers.

The following were the number of "rights" on each island for which claim was made in the courts of the territory within the period specified by the enabling act admitting the latter: Hawaii, 11; Kauai, 28; Lanai, 2; Maui, 41; Molokai, 4; Oahu, 58; 144 in all. The largest recorded area covered by a "right" was one of the two around the island of Lanai, 4,152 acres. It is possible, however, that several whose areas have not been computed would exceed this one in extent. The fishery with the smallest recorded area was that of Haua, on the island of Molokai, which has an area of one-half acre.

Owing to its importance as the seat of government, and its larger population, the "fishery rights" of the island of Oahu were more numerous and valuable than those of any of the other islands. Close to Honolulu were two fisheries belonging to one person which brought in a yearly rental of $1,375. On Kauai only a few of the "rights" were of sufficient value to be rented, these being mainly around Waimea and Hanalei, where one rented for $200 a year, while another brought in but $20 a year. Practically no effort was made of recent years to collect rent for any of the fisheries of Hawaii. This was largely owing to the sparseness of the population and the consequent lack of markets

for the sale of the fish, also somewhat to the disinclination of the people to pay rent. The only fishery on Maui for which anything more than a merely nominal rent was exacted was at Kahului, one of the most productive and best managed of the territorial fisheries. Merely nominal rents were exacted for the use of the fisheries around Molokai. Although numerous attempts were made by the owners to collect rent from the fishermen who frequented the waters around Lanai, they were almost uniformly unsuccessful.

Under the old laws the "konohikis," or landlords, were considered to hold these private fisheries for the equal use of themselves and of the tenants on their respective lands. The konohiki had power each year to set apart for himself, after due notice, one given species or variety of fish natural to his fishery. The specific fish so set apart was to be exclusively for the use of konohiki if caught within the bounds of his fishery, and neither his tenants nor others were at liberty to appropriate such reserved fish to their private use, and if one did so that konohiki could compel him to pay five fish for each one so taken wrongfully. Any person, not a tenant, fishing would be fined upon conviction. It was not lawful, however, for the konohiki to taboo more than one kind of fish upon fishing grounds which were adjacent to each other. It was competent, however, for the konohikis, on consultation with their tenants, in lieu of setting apart some peculiar fish to their exclusive use, to prohibit during certain indicated months of the year all fishing of every description upon their fisheries; and during the fishery season to exact of each fisherman among their tenants one-third part of all the fish taken upon their private fishing grounds. The more enlightened konohikis made excellent use of this provision to protect the more important species, notably amaama (the mullet, *Mugil dobula)*, from pursuit by the fishermen during the spawning season.

In Hawaii, as in many other countries, there were what were known as "royal fishes." The list was a long one and comprised the following:

The bonito *(Gymnosarda pelamis)* when off any part of the coast of Lanai.

The albicore *(Germo sibi)* of Hawaii.

The mullet *(Mugil dobula)* of Huleia, Anehola, and Hanalei; squid *(octopus)* and freshwater fishes *(Gobies)* of Kauai.

The shoal fish taken at the following places noted for the abundance of fish frequenting them: Off Oahu—Kalia, Keehi, Kapapa, Malaeakuli and Pahihi. Off Molokai—Punalau, Ooia, Kawai, Koholanui, Kaonini, Aikoolua, Waiokama and Heleiki. Off Maui—The Kuleku of Honuaula, and the same whenever found off said island.

All the following transient fish, viz: The kule *(Trachurops crumenophthalma)*; the anaehole (a young mullet); the alalauwa *(Priacanthus cruentatus)*; the unhukai; the kawelea *(Trachinocephalus myops)*; the kawakawa *(Gymnosarda alletterata)* and the kalaku.

When any of the above species were taken by the fishermen they were to be divided equally between the king and the fishermen. Owing to the fact that it was found to be a difficult matter for the king to collect his share, and the officers appointed for the purpose were found, in some instances, to be oppressing the people, the government in 1851 passed a law granting to the people the free use of the government fisheries, reserving only the right to establish taboo seasons when deemed necessary for the protection of the fisheries.

As these "fishery rights" appeared anomalous and inconsistent with the customs and laws prevailing in this country, the congress, in the enabling act creating the Territory of Hawaii, which took effect June 14, 1900, repealed all laws of the former republic and kingdom which conferred such exclusive rights, subject, however, to vested rights, the latter, however, not to be valid after three years from the taking effect of the act, provided the owner had filed his claim to such in a circuit court of the territory before June 15, 1902. In the event of his establishing such right the territory was authorized to condemn it for public use upon making just compensation to the owner. The territory fought the claim that these were vested rights and two of the cases were finally passed upon by the United States Supreme Court, which upheld the contention that they constituted vested rights. Practically all of the cases have now been adjudicated by the territorial courts and the only thing remaining to be done is to fix upon their values and then pay for them.

MEETING OF COMMITTEE ON SIZE OF FISH, AMERICAN FISHERIES SOCIETY

Washington, D. C., September 21st, 1908, 6 P. M., at Arlington Hotel.

The committee consisted of Mr. Frank N. Clark, of Northville, Mich., chairman; Mr. W. F. Meehan, Harrisburg, Pa.; Dr. S. P. Bartlett, Quincy, Ill.; Mr. Charles G. Atkins, East Orland, Me.; Mr. J. Frank Ellis, Washington, D. C., (substituted for Mr. John W. Titcomb, Washington, D. C.); Mr. Seymour Bower (substituted for Dr. Hugh M. Smith, president of the American Fisheries Society), and Mr. Henry T. Root, Providence, R. I.

There were also present a large number of the members of the American Fisheries Society, who had been invited by the chairman to attend.

The following proceedings were had:

Chairman: This is a meeting on the size of fish, and the committee are now ready to hear from any who wish to make any statement in regard to the size of the fish, and the committee will have a chance to discuss it too.

Mr. Bower: I judge from what Dr. Bartlett said at the meeting of the society that he had something of importance to present with reference to the present standard.

Dr. Bartlett: It gives me pleasure to talk upon this matter in the presence of my old time friend, Clark, and while our interests may run counter as to the size of fish, I have some decided ideas as to the proper numbering of them.

As you all know, my work is practicaly the work of collecting and distributing black bass. The conditions in Illinois are that the water is too warm to sustain the life of the trout, the temperature often reaching eighty or ninety degrees. Consequently our black bass grow large very early, and it is not uncommon at the end of October to find black bass of that year's spawning weighing anywhere from six to eight ounces, and occasionally ten ounces. The earliest product that we take will probably be one inch in length. We have our orders to ship a carload of

fish, to gather them, and our fish may run anywhere from one to two inches in length. The rapid increase each month makes the difference in size at a wonderful variance. It is almost impossible to give the people in Washington with whom we have to deal, a correct idea as to the size by number. For instance, a number one black bass would technically be one inch, but under the ruling it remains a number one bass at two inches. Now a number one bass at one inch is a very minute creature, and a number one bass at two inches will weigh four or five times as much as number one. We may possibly put up the first catch of black bass, 300 or 400 to a can, while if they are two inches long 150 will be all that the can will hold. So that in getting our orders from Washington to distribute 10,000 fish in a carload, we are in trouble. Last week I had an order from Washington to put 10,000 black bass in a car, and all we could put in was 3,500, because the fish had increased in size so rapidly.

I would suggest that the numbers instead of running by the inches, run, for instance one inch, number one; one and one-quarter inch, number one a; one and one half inch to one and three quarters, number one b; and so on up.

I make that suggestion to fit the conditions present in Illinois. I am not here to dictate what ought to be done for different stations or places. I am talking about the conditions that exist in the warm water of the state of Illinois. That would be my suggestion.

Mr. A. G. Keesecker, Erwin, Tenn., (Supt. Bureau of Fisheries Station): I would like to say that my principal objection to the present system is that the number is taken from the largest size of fish. For instance, the number two is a fish from one to two inches long.

Mr. Meehan: No, number two is over two inches long and less than three.

Mr. Keesecker: Then why not make this run the other way and instead of making that number the limit of the size make it the medium? The gentlemen that are raising trout will understand that trout vary in size and length very much, and unless you keep grading them very often there will be a variance in size, and my way of numbering would be to strike the average size

of the fish and to call them by numbers; and it seems to me that this average size ought to be the midway size instead of being either the smallest or largest fish that are designed by a number. Suppose we call a fish one and one-half inches long, number one, nd from one and a half to two and a half number two, making the number the midway size of the fish, letting the average be half each way.

Mr. Meehan: My recollection was when we agreed upon making numbers that way, namely, number one from one inch up to two, and so on, was for the very reason that Mr. Keesecker has stated—that we were speaking particularly of trout, and that trout in a trough would vary in size in a very short time, from one to two inches; and therefore we took the number one as representing the average fish, that is, from one inch to less than two, and I consider it to be the fairest and best means of designation. Of course it was more particularly trout that we were talking about, but we applied it to all fish.

Mr. John L. Leary, San Marcos, Texas., (Supt. of Station): Our fish grow very fast and the term fingerlings does not apply to our later fish at all. They ought to be called yearlings. But I believe if we would say that fry and advanced fry should be the designation given to fish up to one inch, and then for all from one inch to two inches number one, and two inches to three number two, that that would be a better plan.

Mr. Meehan: It is so stated. A fry is a fish with a sac on; it is an advanced fry when the sac is absorbed; and it is less than one inch in length; and it is number one when the fish is from one to two inches long.

Mr. E. N. Carter, St. Johnsbury, Vermont: I think we had better make use of weights in connection with the numbers; for instance call them 1, 4s, or, 1, 5s, the 5s designating the weight of the fish, or something of that kind. I do not know what a good bass of a certain size would weigh, but it seems to me it would be easy to determine that by means of properly constructed scales, and we would know that the number one would refer to a fish between the length of one inch and two inches, and, as has already been pointed out, fish running from one to

two inches may vary greatly in size and weight, and I believe that a more definite determination could be arrived at by using the weight in connection with the method already adopted.

Mr. Henry T. Root, Providence, R. I.: I would say that that is the way we buy our trout, by weight. I will go down and order a hundred trout but I order them by weight. We get less trout as the fish advances in weight, but people are better satisfied, and I do not see why that principle cannot be applied to all fish.

Mr. Meehan: You would have a great job with whitefish.

Mr. Carter: The system of weights is used all over the country. A pound is a pound everywhere. If Dr. Bartlett weighs a lot of fish and knows a certain size has a certain weight, he can telegraph to Washington, and they will know just what those fish are.

Dr. Bartlett: The purpose of this inquiry, as I understand it, has been for the convenience of the gentlemen at the head of the Bureau of Fisheries, and covers the work of twenty-five or thirty of us in the country who are superintendents, and it is to arrive at some kind of a fixed plan by which they may know what we are giving them, that this meeting is called. I suppose the service is the same with all, and the proposition, as I understand it, is that when we have shipped a carload of fish we ought to give an approximately correct idea of what we have actually shipped. With black bass it is hard to do that, where you have a number one running from one to two inches. I do not know anything about trout work, or in the growth of trout how it would be applied. I am talking simply from the standpoint of those black bass that are taken from sloughs where the waters are very warm and they grow very rapidly, so that by the time we have cleaned out a pond we may have a dozen different sizes, and we may take fish out of some of those places where we would have many fry that would go from one inch up to two inches, and lots of them that would go up to four or five inches. I know it is a little bit difficult, and perhaps I am a little bit selfish in insisting on the committee changing the regulations as to size, but those are my reasons. I am only speaking for one locality and not as applied to the whole.

Mr. Bower: I do not see how the doctor is going to tell how many of each particular kind he has, if he draws the line too fine. The fish will vary an inch or two in length in the small hatch. Now if we get down to quarter sizes how will we tell the number of each without sorting and counting? As long as we all use the same standard and strike a fair average the presumption is we will have as many a little under size as over size, and it is as fair for one as it is for another. I do not see how we can draw the line as fine as a quarter of an inch as bass grow so rapidly and unevenly. I believe it will be impracticable to separate them into quarter inch sizes. I do not see how we can work the doctor's plan, thought perhaps Mr. Root's plan of weighing them is all right.

Dr. Bartlett: But with us we separate our bass closely as to size in troughs while holding them there, and I do not know how you find it in your hatcheries, but certainly a quarter of an inch makes enough difference in size frequently for a very rapid destruction of fish if held any length of time, and if they can be separated into those sizes why cannot they be separated so as to account for them by number? This is simply a suggestion and simply applies to my individual work, as I say, and I present it so that it may be considered.

Mr. Lydell, Superintendent, Mill Creek, Mich.: The present plan suits me very well. If we sorted our bass as number one a tonight, tomorrow morning they would be number one b, and when I say to the fish commission I have put out 100,000 number ones, they know they are between an inch and two inches, and if you want them closer, say number two from one and a half inches to two and a half inches, but do not cut it any closer than half inches; but we have no trouble under the present plan. If a fish culturist can ship his fish number one, he will not wait for two inches, and call them number one. I have shipped 190,000 number ones this year, and not one over an inch and a half. I think that would be the policy of all culturists—if they can ship them and call them number one at an inch, they will not wait till they are two inches. Of course it is possible when fish are collected from sloughs and in a number of lengths something

like the plan suggested by Dr. Bartlett would be better, but the present plan suits us in Michigan very nicely.

Chairman: You chairman wants to say a word or two. I have looked this audience over here, and it is larger than some of the American Fishery Society meetings that I have attended. I am glad to see so many, and I notice that there are present here seventeen practical fish culturists. This of course includes Mr. Meehan, which is a little doubtful but we will let it pass. (Great laughter.) Now of those seventeen, they have been working on this basis of number one, two, three, etc. Now how many of those seventeen are dissatisfied with the present plan? I would just like to know for the sake of argument. I will ask all to hold up their hands that are dissatisfied with the present plan.

A vote was then taken which showed eight to five in favor of the present plan.

Dr. Bartlett: I submit to the majority.

Mr. Clark: Of course this is going to be finally left to the committee, but I would just like to ask why this would not be a good plan to get at what the doctor wants:

Number ones: 1¼ inch.

Number ones: 1½ inch.

Number ones: 1¾ inch.

Then number two: 2 inches, 2½ inches, and 2¾ inches, and so on. Why is not some such plan as that best?

Mr. E. E. Race, Superintendent, Green Lake, Me.: Why add more to our arduous duties, without giving us better results? Why have six or seven designations instead of those we already have? In other words, if the designations now are for bass only, I do not know how it works; but for brook trout and salmon, land-locked, it would be impossible to weigh them at this season because they would die before transporting them five miles from the station. I have thought the thing over very carefully for several years, and it seems to me that the way it is now arranged, for all practical purposes, both for the bureau and stations, it will be very hard to improve. It might be of advantage for some localities, but take it as a whole it would be very unwise to change it.

Mr. Bower: We might make one more subdivision and help the doctor out a good deal in his work in this way:

Make number one cover fish from 1 to 1½ inches in length; then, 1 plus, fish from 1½ inches to 2 inches; then let number 2 cover fish from 2 to 2½ inches; and 2 plus cover fish from 2½ inches to 3 inches in length, and so on. That is simple. Just add "plus" for the last half inch and leave it off for the first half inch.

Mr. Race: In the station where I am located we have a large number of fish. In one pond are fish four to five inches long, and in another pond the fish are smaller, though they are of the same age, and might be designated as number one while the others and fours. If the fish were all uniform in size it might be possible that it would be advantageous to make the change, but when we have so great a variation in the different ponds it seems to me it is impossible to improve on the present plan.

Mr. Charles G. Atkins, East Orland, Me.: I wish to second what Mr. Race says, that if you subdivide the fish any more you increase very greatly the difficulty of estimating their sizes. We cannot stop and measure them. We have got to look into the water and guess at them; and it seems to me when they are arranged as they are now, that the guessing is about as close as we can make it, and about as near as we can get at it.

Mr. Carter: Up at St. Johnsbury we screen our fish. At Arlington where we raise fish we have a series of screens of various sizes. Mr. J. P. Schneider started this thing over at Arlington, and we have our fish in a trough, may be 2,000, 3,000, 4,000, or 5,000, whatever they are, and we start one screen at one end and one at the other end, and work one screen to the center, and commence at the head of the trough and work the other screen towards that; and you will be surprised to find how equally we can sort the fish out into two sizes. In a short time you can sort a great many thousand fish without injury to any single fish.

Mr. W. T. Thompson, of Leadville, Colo., (Supt. of Station): I want to say a word about the measuring of fish. Of course when we have had any rule in force for a while we are likely to find the little weakness in it. Some one presents a new

idea, naturally presenting only its best side. We do not see the weaknesses in this new proposition until we give it our careful consideration. Take this weighing of fish, take fish of the same size, say an inch and a half or two-inch fish, compare those raised in cold water, with others raised in what we would call comparatively warm water; those in the warmer water will eat a great deal more, they grow rapidly, and will be deep, broad and heavy, probably weighing from one and a half to two times as much as fish grown in cold water. The cold water fish do not eat as much and are much more slender. Now here is a chance for variation in weight just as much as in length. On the other hand you talk about subdividing them into fingerlings one, one and a quarter, one and a half, and one and three-fourths inches in length. How many troughs do you get hold of where you can get the division down that fine without weekly, I might say daily, sorting? You call them fingerlings number one and will have fish varying at least a half inch, possibly more. It will be the same way all along. Now how are you going to get down quite as fine as a quarter of an inch? Even if you do, what practical purpose will be subserved anyhow? When you start in with a fingerling number one, naturally you ship more to the can, if your season is prolonged for a week or two it is true you get a few less in the can. But it is impracticable to get it down to the absolute unit; we cannot stop and count each individual fish. Take our case at Leadville: We have forty-eight nursery pens. When we make a shipment it usually means from seventy-five to one hundred and fifty cans. We move practically all our fish in special cars furnished by the railroads. Now we cannot get down that fine, to the absolute unit, I mean, and I do not believe anyone else can. It is not practical where you are handling large numbers of fish. What can you gain by it anyhow, except to put a little more work on the already hard-working superintendents?

Mr. H. D. Dean, Superintendent, Neosho, Mo.: I believe a letter would be better than a figure. Then why not, if you put 100 in a can, 100 number one, 200 number two, and so on up to a thousand, tell the Washington office right away how many you think you could ship in a can.

Mr. Thompson: Difference of opinion still.

Mr. Dean: Then there ought to be a machine made to run through and tell exactly what the fish weigh and Washington should furnish the machine.

Mr. Bower: The Washington authorities should give superintendents more leeway and let them ship what size is best in their judgment.

Mr. Lydell: I do not think numbers per can would do any good. We sometimes put 100, 200 or 500 in a can, according to the distance we ship, although the fish may be of the same size. That would be very misleading I should think, in that way.

Mr. Ellis: I think the present arrangement suits the office very well. If there must be a change I think Dr. Bartlett's is the best proposition—not the quarter but the half inch.

Chairman: Why not put plus on them, as Mr. Bower suggests?

Mr. Ellis: I think it would be better for the records to use a, b, c, number one a, etc., and that would mean the half inch.

Mr. Lydell: If we change the present plan we will cause ourselves a whole lot of work.

Chairman: What does the committee think of this plan? For instance, number one a, number one b,—number one a would be from one inch to an inch and a half, and one b would be from an inch and a half to two inches, etc., and let those use that that want to. If I am sending out fish I prefer to use number one all right. That suits me and I use it. They are number ones. Now if I care to or if our office or if Mr. Lydell in the state cares to use it, or if his superintendent wants him to use it, then he will do so. Let it be optional with the different commissions. Mr. Bower concludes number one is good enough for them, and number one may mean an inch or an inch and three quarters; it is optional with him to use it, and it would be optional with the United States, or Connecticut or Rhode Island, etc.—we must formulate some report.

Mr. Meehan: Then we will be getting into confusion. We have got to consider something else besides our office work or the

hatcheries; we have got to consider that for years we were all mixed up with the people themselves. When the state shipped directly to the people one would call the fish fry, another would call it fingerling, etc. Now we are beginning to make the people who receive fish understand what we mean when we say fingerling and fingerling number one. Now if we make a change again and quit that making it plus or a, b, c, or whatever you may call it, we must teach the public all over again; and I think that any change should be made with the greatest of caution, not only on account of the extra work which it will give the superintendents and the office, but the trouble again with the public; and I myself believe that we ought to hold to the regulations that we now have without change. I think it would be a mistake to make it optional. If we do make a change it should be recommended as general so there won't be the confusion among the different states again. There would be confusion if Michigan put in a, and Rhode Island kept the fingerling, and Pennsylvania kept to a1, or b1, or plus—there would be confusion again, and I do not think it would be good policy.

Dr. Bartlett: I confessed on the start that this was practically a selfish matter, so far I was personally concerned. Drop the black bass for a moment and go on to the bream. Now there is a fish that we commence moving at from three-eighths to one-half inch in length, and the crappie is practically the same. If you get a bream or crappie that would go an inch and three-fourths, you have a fish way beyond number one, because it must be late in the season before it would attain that size.

Mr. Meehan: I understand what our men mean when they say number one bream. I understand they have got them between one and two inches.

Mr. Leary: We should drop the word fingerling as to fish under one inch long. Say fry, advanced fry, number one and two, and then commence: number one fingerling, number two fingerling, number three fingerling, number four fingerling, number five, six, seven, eight, nine and ten fingerling, and that would cover the bream, crappie and all other small fish.

Mr. Atkins: It seems to me that those who wish to subdivide

fish still more, or are called upon to do so, might make such a division as this: Small number ones, medium number ones, and large number ones. It seems to me that would be entirely satisfactory, and the regulation could remain as it is. Those who do not choose to designate the fish in that way need not be compelled to do so.

Chairman: If there is nothing further to be discussed, what does the committee wish to do about this?

Mr. Carter: We have one, two and three fingerlings and then come to yearlings, etc. How do we designate and distinguish between yearlings and adults? When are they adults. I do not think that has ever been settled.

Chairman: I call a fish an adult when it is ready to spawn for the first time. A trout is adult at eighteen or nineteen months, and small-mouth black bass become adult at three years old.

Mr. Carter: There should be some age set as to when they are called adults, for the sake of uniformity.

Mr. Meehan: The regulations call for one year old, two year old and three year olds.

Mr. Bower: I was born and raised on a farm, and in that section calves are always called yearlings until they are two years old, and two year olds until they are three; so with fish, they should be called yearlings until they are two years old; that is, the universal rule and custom.

Mr. Meehan: That is so with us, and that is supposed to be the regulation.

Mr. Meehan: I move that this committee report that it is inexpedient to recommend a change in the present regulations.

Mr. Bower: I support the motion.

Dr. Bartlett: I move that the present regulations, with the exception of dividing by the half inches, be retained, and I move to amend the motion by making it into the half inches, that is, number one running up to the half, etc., as suggested.

Mr. Bower: How do you designate it? One a, etc.?

Dr. Bartlett: The designation, "number one," could be used for a fish from an inch to an inch and a half in length; "Number one A," for a fish from one and a half inches in length to two inches in length.

Amendment seconded.

Mr. Bower: This having both A and B is confusing. It makes B mean more than A, whereas A usually has the greater value. The plan I suggested of using the term "plus" is correct in principle, but I think Mr. Ellis' and Mr. Dean's idea of using a letter is much better. Call all fish from one to one and a half inches in length, No. 1; from one and one-half to two inches, No. 1-A; from two to two and one-half inches, No. 2; from two and one-half to three inches, No. 2-A, and so on. I will support that plan.

Mr. Meehan: I will accept that amendment.

Dr. Bartlett: I support that.

Chairman: Then I understand that it is Number one from one inch to one and a half; and Number one A from one and a half to two inches.

Motion put and unanimously carried.

Chairman: The chairman agrees to it and the committee will report in that way, that the present regulations be amended to read accordingly.

The committee reports that the regulations regarding the size of fish remain the same, excepting that there be a subdivision of the numbered fingerling class to be designated by the letter a, to-wit: Fingerling number one, one inch and less than an inch and a half; Number one A, one and a half inch, and less than two, and so on.

The committee then adjourned.

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Webster, B. O., *Bellefonte, Pa.*
Webster, H. A., *Oregon City, Ore.*
Wentworth, E. E., *U. S. Bureau of Fisheries, Concrete, Wash.*
Wessel, Joseph A., *Crookston, Minn.*
Wheeler, Charles Stetson, *Union Trust Building, San Francisco, Cal.*
Whipple, Hon. Jas. S., *Commissioner of Forestry, Fisheries and Game, Capitol, Albany, N. Y.*
Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*

White, R. Tyson, *320 Bridge Street, Brooklyn, N. Y.*
Whitaker, Hon. Andrew R., *Phoenixville, Pa.*
Wilbur, H. O., *235 Third Street, Philadelphia, Pa.*
Willard, Charles W., *Westerly, R. I.*
Wilson, C. H., *Glens Falls, N. Y.*
Winn, Dennis, *U. S. Bureau of Fisheries, Oregon City, Ore.*
Winn, S., *Carolina, R. I.*
Wires, S. P., *U. S. Bureau of Fisheries, Lester Park, Duluth, Minn.*
Wolf, Herman T., *489 The Bourse, Philadelphia, Pa.*
Wolthers, Chas. A., *Oxford & Mervine Streets, Philadelphia, Pa.*
Wood, C. C., *Plymouth, Mass.*
Worth, S. G., *U. S. Bureau of Fisheries, Beaufort, N. C.*

Young, Capt. John L., *Atlantic City, N. J.*

Zacharie, Col. F. C., *345 Corondelet Street, New Orleans, La.*
Zalsman, P. G., *Bayfield, Bayfield County, Wis.*
Zweighaft, S., *Deer Park, Haines Falls, N. Y.*

LIFE MEMBERS.

Birge, Prof. E. A., *University of Wisconsin, Madison, Wis.*
Brower, J. F., *Torresdale Hatchery, Holmesburg, Pa.*
Buller, A. G., *Union City, Pa.*
Buller, Howard M., *Bellefonte, Pa.*
Buller, Nathan R., *Pleasant Mount, Pa.*
Buller, William, *Corry, Pa.*
Corliss, C. G., *U. S. Bureau of Fisheries, Gloucester, Mass.*
Cruickshank, James, *275 Central Park West, New York City.*
Dominy, Jeremiah M., *South Haven, New York.*
Fearing, Daniel B., *Newport, R. I.*
Haas, William, *Corry, Pa.*
Hogan, J. J., *Madison, Wis.*
Meehan, W. E., *Commissioner of Fisheries, Harrisburg, Pa.*
Safford, W. H., *Department of Fisheries, Harrisburg, Pa.*

HONORARY MEMBERS.

The President of the United States.

The Governors of the several states.

Adams, Fred J., *Grand Rapids, Mich.*

Antipa, Prof. Dr. Gregoire, *Inspector General of Fisheries, Bucharest, Roumania.*

Besana, Mr. Guiseppe, *President of the Lombardy Fisheries Society, Via Rugabella 19, Milan, Italy.*

Borodine, Nicholas, *10th Linie 5, St. Petersburg, Russia.*

Cortelyou, Hon. George B., *Washington, D. C.*

Denbigh, Lord, *Colonel of the Honorable Artillery Company, London, England.*

Fish Protective Association of Eastern Pennsylvania, *1020 Arch Street, Philadelphia, Pa.*

Fryer, Charles E., *Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, 3 Delahay Street, London, England.*

Hoek, Dr. P. P. C., *Scientific Fishery Adviser of the Dutch Government, Haarlem, Holland.*

Hofer, Prof. Dr. Bruno, *Biological Experiment Station, Munich, Germany.*

Kishinouye, Dr. K., *Imperial Fisheries Bureau, Tokyo, Japan.*

Kitahara, Dr. Tasaku, *Imperial Fisheries Bureau, Tokyo, Japan.*

Lake St. Clair Shooting and Fishing Club, *Detroit, Mich.*

Lawrence-Hamilton, Dr. J., M. R. C. S., *30 Sussex Square, Brighton, England.*

Matsubara, Prof. S., *President Imperial Fisheries Institute, Tokyo, Japan.*

Metcalf, Hon. Victor H., *Secretary of the Navy, Washington, D. C.*

New York Association for the Protection of Fish and Game, *New York City.*

Nordqvist, Dr. Oscar Fritiof, *Superintendent of Fisheries, Lund, Sweden.*

Peck, Hon. George W., *Milwaukee, Wis.*

Perrier, Prof. Edmond, *Director National Museum of Natural History, Paris, France.*

South Side Sportsmen's Club, *Oakdale, L. I., N. Y.*

Steindachner, Prof. Dr. Franz, *Royal Natural History Museum, Vienna, Austria.*

Vinciguerra, Dr. Decio, *Director Royal Fish Cultural Station, Rome, Italy.*

Von Grimm, Dr. Oscar, *Inspector-General of Fisheries, St. Petersburg, Russia.*

Von Kadich, Dr. Heinrich, *Department of Forestry and Domain, Vienna, Austria.*

Von Pirko, Franz, *President Austrian Fishery Society, Vienna, Austria.*

Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING MEMBERS.

Ayson, Lake F., *Commissioner of Fisheries, Wellington, New Zealand.*

Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*

Apostolides, Prof. Nicoly Chr., *Athens, Greece.*

Armistead, J. J., *Dumfries, Scotland.*

Birbeck, Edward, M. P., *London, England.*

Calderwood, W. L., *Inspector of Salmon Fisheries, Edinburgh, Scotland.*

Feilding, J. B., *Upper Downing, Holywell, North Wales.*

Giglioli, Prof. Enrico H., *Florence, Italy.*

Higginson, Edwardo, *Consul for Peru, New York City.*

Jaffe, S., *Osnabruck, Germany.*

Landmark, A., *Inspector of Norwegian Fresh Water Fisheries, Christiana, Norway.*

Marston, R. B., Esq., *Editor of the Fishing Gazette, London, England.*

Olsen, Dr. O. T., *Grimsby, England.*

Poiteau, Charlney, *Lommel, Belgium.*

Raveret-Wattel C., *Director of Agricultural Station at Nid-de-Verdier, 20 Rue des Acacias, Paris.*

Sars, Prof. G. O., *Christiania, Norway.*

Solsky, Baron N. de, *Director of the Imperial Agricultural Museum, St. Petersburg, Russia.*

Trybom, Dr. Filip, *Stockholm, Sweden.*

RECAPITULATION.

Active	411
Life	14
Honorary	73
Corresponding	18
Total membership	516

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this society. In case members do not pay their fees, which shall be two dollars per year, after the first year and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of twenty-five dollars, become a life member of this society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this society shall be a president and a vice president, who shall be ineligible for election to the same office

until a year after the expiration of their term; a corresponding secretary, a recording secretary, a treasurer and an executive committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the society is not in session—four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the executive committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by president.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Standing committees.
5. Committees appointed by the president.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
6. Reading of papers and discussion of same.
    (Note.—a. In the reading of papers preference shall be given to the members present.
    b. The president and two secretaries are empowered to arrange the papers of the meetings of this society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The constitution of the society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said meeting.

The thirty-eighth annual meeting of the American Fisheries Society will be held in July, 1909, in the Yellowstone National Park.

Division of Fisheries
U. S. National Museum

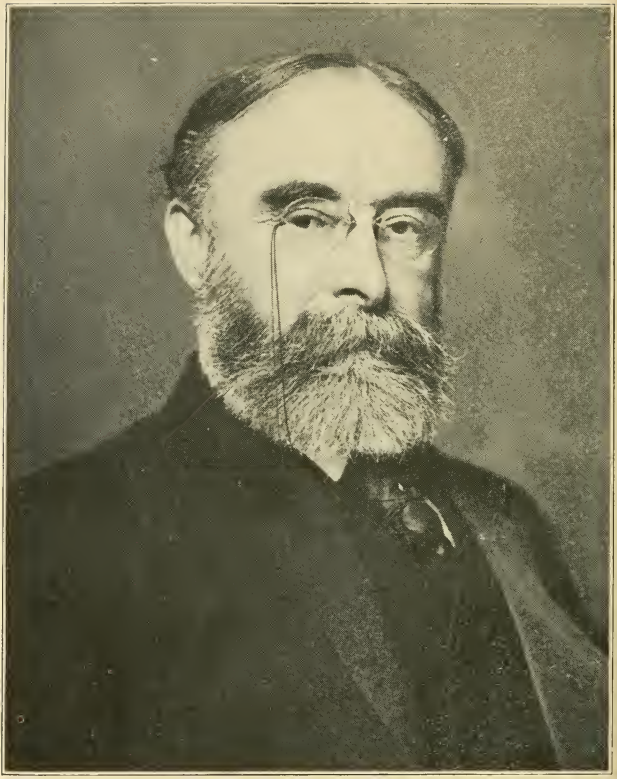
TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

JUN 25 19

NINETEEN HUNDRED NINE



GEORGE FREDERICK PEABODY

President of the American Fisheries Society 1898 1899

Born 1845 Died 1909

TRANSACTIONS

OF THE

AMERICAN

FISHERIES SOCIETY

AT ITS

Thirty-ninth Annual Meeting

JULY 27-28, 1909

At Toledo, Ohio

WASHINGTON
PUBLISHED BY THE SOCIETY
1910

W. F. ROBERTS COMPANY
WASHINGTON, D. C.

OFFICERS FOR 1909-1910

*President*_____SEYMOUR BOWER, Detroit, Mich.

*Vice-President*_____W. E. MEEHAN, Harrisburg, Pa.

*Recording Secretary*__GEORGE F. PEABODY, Appleton, Wis.

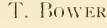
Assistant Recording Secretary,

WARD T. BOWER, Washington, D. C.

Corresponding Secretary,

CHARLES G. ATKINS, East Orland, Me.

*Treasurer*_____C. W. WILLARD, Westerly, R. I.



EXECUTIVE COMMITTEE

S. F. FULLERTON, *Chairman*, St. Paul, Minn.

C. H. TOWNSEND, New York City.

G. H. LAMBSON, Baird, Cal.

GEO. T. MATHEWSON, Thompsonville, Conn.

FRANK MILLER, Put-in Bay, O.

JABE ALFORD, Madison, Wis.

C. H. STEVENSON, Detroit, Mich.

AMERICAN FISHERIES SOCIETY

Organized 1870

The first meeting of the Society occurred December 20, 1870. The organization then effected continued until February, 1872, when the second meeting was held. Since that time there has been a meeting each year, as shown below, and the last meeting, in July, 1909, was consequently the thirty-ninth. The respective presidents were elected at the meeting, at the place, and for the period shown opposite their names, but they presided at the subsequent meeting.

PRESIDENTS, TERMS OF SERVICE, AND PLACES OF MEETING.

1. William Clift ---------1870-1872----New York, N. Y.
2. William Clift ---------1872-1873----Albany, N. Y.
3. William Clift ---------1873-1874----New York, N. Y.
4. Robert B. Roosevelt----1874-1875----New York, N. Y.
5. Robert B. Roosevelt----1875-1876----New York, N. Y.
6. Robert B. Roosevelt----1876-1877*---New York, N. Y.
7. Robert B. Roosevelt----1877-1878----New York, N. Y.
8. Robert B. Roosevelt----1878-1879----New York, N. Y.
9. Robert B. Roosevelt----1879-1880----New York, N. Y.
10. Robert B. Roosevelt----1880-1881----New York, N. Y.
11. Robert B. Roosevelt----1881-1882----New York, N. Y.
12. George Shepard Page--1882-1883----New York, N. Y.
13. James Benkard -------1883-1884----New York, N. Y.
14. Theodore Lyman -----1884-1885----Washington, D. C.
15. Marshall McDonald ---1885-1886----Washington, D. C.
16. W. M. Hudson --------1886-1887----Chicago, Ill.
17. William L. May ------1887-1888----Washington, D. C.
18. John H. Bissell -------1888-1889----Detroit, Mich.
19. Eugene G. Blackford---1889-1890----Philadelphia, Pa.
20. Eugene G. Blackford---1890-1891----Put-in Bay, Ohio
21. James A. Henshall ----1891-1892----Washington, D. C.
22. Herschel Whitaker ----1892-1893----New York, N. Y.
23. Henry C. Ford --------1893-1894----Chicago, Ill.
24. William L. May ------1894-1895----Philadelphia, Pa.
25. L. D. Huntington -----1895-1896----New York, N. Y.
26. Herschel Whitaker ----1896-1897----New York, N. Y.
27. William L. May ------1897-1898----Detroit, Mich.
28. George F. Peabody----1898-1899----Omaha, Nebr.
29. John W. Titcomb------1899-1900----Niagara Falls, N. Y.
30. F. B. Dickerson -------1900-1901----Woods Hole, Mass.
31. E. E. Bryant ---------1901-1902----Milwaukee, Wis.
32. George M. Bowers-----1902-1903----Put-in Bay, Ohio
33. Frank N. Clark -------1903-1904----Woods Hole, Mass.
34. Henry T. Root--------1904-1905----Atlantic City, N. J.
35. C. D. Joslyn ---------1905-1906----White Sulphur Springs, W. Va.
36. E. A. Birge ----------1906-1907----Grand Rapids, Mich.
37. Hugh M. Smith-------1907-1908----Erie, Pa.
38. Tarleton H. Bean-----1908-1909----Washington, D. C.
39. Seymour Bower ------1909-1910----Toledo, Ohio

*A special meeting was held at the Centennial Grounds, Philadelphia, Pa., October 6 and 7, 1876.

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PART I
BUSINESS SESSIONS

Transactions of the American Fisheries Society

Tuesday, July 27, 1909.

Meeting called to order at 10 a. m. by the President, Dr. Tarleton H. Bean, at the Secor Hotel, Toledo, Ohio.

PRESIDENT: Before proceeding with the regular order of business, I regret to have to announce the absence on account of serious illness of our worthy recording secretary, Mr. George F. Peabody. Mr. Peabody is now in the Presbyterian Hospital at Chicago, under the care of a specialist, and his condition is really alarming. It is on this account that Mr. Peabody, whose presence would be so delightful to us all, is compelled to be away. I do not know just how the members of the Fisheries Society will feel, but, for my own part, I shall miss Mr. Peabody as a very old friend who has been identified with this Society for many years, and who has done a vast amount of work which has inured to our benefit.

The following letter concerning Secretary Peabody has come to me from Mr. J. D. Steele, under date of Appleton, Wis., July 22:

"It is the unfortunate duty of the writer to tell you of the unexpected and I fear serious illness of Mr. Peabody, who was last night removed to the Presbyterian Hospital in Chicago, where he is under the care of Dr. B. H. Sippy, the stomach specialist. A stomach disorder of long standing has become acute and an operation may be necessary, this to be determined after a thorough examination.

"Unless a miracle happens within the next few days, it will be utterly impossible for Mr. Peabody to attend the Fisheries meeting at Toledo. It is a matter of keen disappointment to Mr. Peabody to be put out of commission just at this time. Any communications which you may want to send him will reach him if forwarded to his usual Appleton address."

A later letter addressed to me from Mr. Steele was to the effect that an operation would be performed. As to the re-

sult of the operation I am still in ignorance, but I hope all things will turn out for the best.

Mr. S. F. Fullerton, St. Paul, Minn.: Since Mr. Peabody is ill, I think there ought to be an acting recording secretary, and I take great pleasure in nominating Mr. Ward T. Bower for that position.

Motion seconded by Mr. W. E. Meehan, of Pennsylvania.

President: I was about to bring that up myself, before proceeding any further with the order of business. Of course, we cannot transact business without having a record, and you have heard the motion. The nomination of Mr. Ward T. Bower as acting recording secretary is made.

Motion unanimously carried.

Mr. Ward T. Bower, Washington, D. C.: I shall endeavor to do the best I can with the office of lengthy title.

President: Before the roll call of members is taken it would be best for me to announce that upon this table there are cards for application for membership, and I trust that they will be used. Mr. Bower also has an announcement to make, coming from one of our esteemed members in Washington.

Mr. Ward T. Bower: Through me the Hon. George M. Bowers, Commissioner of Fish and Fisheries, sends his greetings to the Society, and at the same time regrets his inability to be present at the opening of the meeting. He states that it is possible but hardly probable that he will be in attendance later on. He wishes and sincerely trusts that the meeting will be a success in every way. I am sure that it is a matter of regret to all that the Commissioner cannot be present with us upon this occasion. It is also to be deplored that Dr. H. M. Smith, the deputy commissioner, cannot be with us.

There was one duty that the Commissioner particularly charged me with. It is his earnest wish that the names of the President of the United States, the Honorable William Howard Taft, and the Secretary of the Department of Commerce and Labor, the Honorable Charles Nagel, be presented

to this Society for honorary membership. Therefore, I have the honor to make a motion to that effect.

PRESIDENT: I would suggest that we hold this matter in abeyance until the general subject of election of members comes up, and in the meantime, if you will permit, I would like to announce a committee on the reading of papers. There are some articles lying on this desk which are ready for use. There is also a provisional program to which reference can be made. I understand that some of the authors desire to be heard as soon as possible. Therefore, I think the whole subject should be referred to a committee, and we can then proceed in an orderly manner. I would name on that committee:

Mr. John E. Gunckel, of Toledo; Mr. Seymour Bower, of Detroit, and Mr. Charles H. Stevenson, Washington, D. C.

The roll call of members is the next order of business.

MR. C. W. WILLARD, Westerly, R. I.: The roll has usually been called by the use of cards to be passed in by the different members who are present, and the cards are here at the stenographer's desk.

PRESIDENT: I am reminded that the turning in of the cards constitutes the roll call. Please bear in mind that if any members come in later they should hand in cards.

The registered attendance at the meetings of the Society was as follows:

Bean, Dr. Tarleton H., Albany, N. Y.
Boardman, W. H., Central Falls, R. I.
Bower, Seymour, Detroit, Mich.
Bower, Ward T., Washington, D. C.
Brass, J. L., Drayton Plains, Mich.
Brown, Clarence, Toledo, Ohio.
Brown, Geo. M., Detroit, Mich.
Burnham, Chas. W., Tupelo, Miss.
Catte, Eugene, Langdon, Kansas.
Clark, Frank N., Northville, Mich.
Conway, R. J., Detroit, Mich.
Dean, H. D., Neosho, Mo.
Dickerson, G. C., Harrietta, Mich.
Downing, S. W., Put-in Bay, Ohio.
Englert, Andrew, Castalia, Ohio.

Evans, Barton D., Harrisburg, Pa.
Evermann, Dr. Barton Warren, Washington, D. C.
Filkins, B. G., Northville, Mich.
Fullerton, Samuel F., St. Paul, Minn.
Goodwin, H. D., Milwaukee, Wis.
Gunckel, John E., Toledo, Ohio.
Hartman, Phil. H., Erie, Pa.
Jennings, G. E., New York, N. Y.
Lydell, Dwight, Comstock Park, Mich.
Marks, H. H., Sault Ste. Marie, Mich.
Marks, J. P., Paris, Mich.
Meehan, W. E., Harrisburg, Pa.
Miller, Frank, Put-in Bay, Ohio.
Miller, Frank M., New Orleans, La.
Morton, W. P., Providence, R. I.
North, Paul, Cleveland, Ohio.
O'Brien, W. J., Gretna, Nebr.
Pomeroy, Geo. E., Toledo, Ohio.
Runion, H. P., Benkelman, Nebr.
Safford, W. H., Conneaut Lake, Pa.
Stevenson, Charles H., Washington, D. C.
Thayer, W. W., Detroit, Mich.
Thomas, W. H., Put-in Bay, Ohio.
Titcomb, John W., Washington, D. C.
Van Atta, Clyde H., Northville, Mich.
Willard, C. W., Westerly, R. I.

PRESIDENT: The treasurer will please read the names of those who have been proposed for membership.

MR. C. W. WILLARD: The following names have been presented for membership:

Ansley, H. M., New Orleans, La.
Boyer, L. A., 38 Drummond St., Montreal, Canada.
Campbell, G. D., Weymouth, Mass.
Day, Dana C., Toledo, Ohio.
Dowling, Dr. Oscar, Board of Bird, Game and Fish Commissioners, Shreveport, La.
Doyle, Henry, Vancouver, British Columbia.
Englert, Andrew, Castalia, Ohio.
Feick, John A., Sandusky, Ohio.
Hart, W. O., 134 Corondelet St., New Orleans, La.
Leis, Herman, Melvina, Wis.
Pfleuger, J. E., Akron, Ohio.
Pomeroy, Geo. E., Toledo, Ohio.
Ponder, Amos L., New Orleans, La.
Porter, O. S., Porterville, Ga.

Postal, Fred, State Board of Fish Commissioners, Detroit, Mich.
Power, D. H., State Board of Fish Commissioners, Sutton's Bay, Mich.
Reed, Dr. H. D., Cornell University, Ithaca, N. Y.
Runion, H. P., Benkelman, Nebr.
Van Atta, Clyde H., U. S. Bureau of Fisheries, Northville, Mich.
Yerington, Edward B., Board of State Fish Commissioners, Carson City, Nevada.

Mr. Ward T. Bower: I move that the names presented be elected to membership.

Motion seconded.

President: I have a letter from Mr. Charles G. Atkins, corresponding secretary, in which he proposes for corresponding membership Mr. S. M. Mohsin, Calcutta, India, representing the Bengal Fishery Department, and Mr. C. Riedel, Bergstedt, Germany. Mr. Atkins writes that Mr Mohsin has been in this country for nearly a year past, studying our fisheries and fish culture, and that Mr. Riedel is a practical fish culturist in his own country. The name of Mr. Charles Flégel, member of the Imperial Austrian Fishery Society, Vienna, Austria, has also been presented for corresponding membership.

Mr. J. W. Titcomb, Washington, D. C.: I second these nominations.

The foregoing nominees to active and corresponding membership were thereupon unanimously elected.

Mr. C. W. Willard: You will note on our list of membership that the President of the United States and the governors of the several states have already been elected honorary members of the Society.

Mr. Frank N. Clark, Northville, Mich.: That will not interfere.

President: It strikes me that that would not interfere, for the reason that the title has passed over to other men since the election. The election is of the man and not of the office and under the circumstances it will be perfectly proper to vote for President Taft and Secretary Nagel.

Mr. Clark: At page 190 of the last printed proceedings, under the head of "Honorary Members," are named "The President of the United States" and "The Governors of the Several States." They are already members, therefore. However, I think as a compliment to the President it would be well to pass this motion, and he should be officially notified of having been elected.

Mr. S. F. Fullerton: Owing to the fact that the governors and presidents are changed quite often, I think the personnel, the men themselves, ought to be elected. *

President: I think it is a very good plan.

Mr. Fullerton: That will include the governor of our state, the Hon. John A. Johnson, who is a great fisherman.

President: The question is on the election of the honorary and active members whose names have been read.

Mr. Meehan: I think Pennsylvania should be added to the list.

President: That is all right—make it an individual matter.

Mr. Willard: If we are to break up this old election of presidents and governors as it has usually been done, and are to name the president and also several of the governors, would it not be well at every meeting to have our secretary prepare a list naming the president and the governors of the different states, and have their names presented, and have constantly on our honorary list the president and the governor of every state by name.

Mr. Meehan: That is right.

Mr. Charles W. Burnham, Tupelo, Mississippi: That would eliminate any personal feeling in the matter.

Mr. Willard: I make that amendment.

The amended motion was made, seconded, and unanimously carried.

Mr. Clark: I move the suspension of the regular order of business for the purpose of offering an amendment to the constitution.

Motion seconded and carried.

Mr. Clark: I would like to move an amendment to Article 3 in reference to the officers of the Society, by inserting after the words "recording secretary" the words "assistant recording secretary."

Seconded by Mr. Meehan.

Mr. Clark: I offer this amendment for the reason that we may, from time to time, be in the same situation in which we now find ourselves, our secretary being absent, and it probably would be unusual that the recording and the assistant recording secretary would both be absent. I therefore offer this amendment and I offer it thus early in order that it may be before the nominating committee so that they can provide for it if necessary.

President: We may act on this amendment to the constitution by a two-thirds vote.

Mr. Meehan: I would suggest a standing vote.

The amendment was carried, 23 voting affirmatively out of 32 in attendance at the time.

President: The motion is carried by a bare majority and the constitution is amended.

ADDRESS OF PRESIDENT.

I see that by the constitution the President is to make a report. I was not aware of this fact, and I do not propose to take up very much of your time, but there is one matter that has come within my own experience as state fish culturist of New York which I think will be of interest to the American Fisheries Society. It is the living question of fish diseases causing epidemics and involving losses of thousands and tens of thousands and in some cases hundreds of thousands of fish at a single hatchery in a single season. While making this report I do not intend to anticipate what I have to say in my paper which lies here on the table. But I desire to call your attention to the fact that this state of affairs is a living issue with the fish culturists of the United States and of every country today, and it is one that must be met. How it is to be met you can help, I am sure, to decide. I have been

unable to. I have to turn for information from one source to another, and, as you will see when you look over the list of papers, I have catalogued, with my comments upon them, and the recommendations I have made, I know you will agree with me that it is a problem of a most serious and engaging nature.

Now, this question has been pressing upon us since we last met, but it is not new. Fish diseases are as old as the hills, and yet fish diseases have not been studied as long as the hills have been under the observation and investigation of scientific men. We are new in the study of fish diseases. We go to Germany for information. The scientific men of Germany take time to study these problems. I do not know whether they are better paid than we are or not; but at all events they find time. They get the opportunity to study fish diseases and we go to them for such little scraps of information as we can get. You all know that we do not get very much. We read about lymphosporidium, micrococcus, bacterium, and bacillus, and we are often inclined to wish that this jangle of words might find its way into the sea and be buried out of sight; yet we cannot afford to feel that way about it because the beginning of things lies in the investigation of the actual origin of disease. Treatment comes later on. In American literature on the subject there is little to help us. Dr. Hofer's book, in the German, gives some descriptions and a few lines of suggestions for treatment. There is the problem today; we know that these diseases occur; the fish are dying before our eyes. The different states and the United States are losing tens of thousands of dollars annually—perhaps more than that—from this cause; and our best results are brought to naught. As I say, that is the problem and the living problem before us today.

I do not know that there is anything else for me to report which would be of much interest to you. I can merely say that work in fish culture has been steadily growing during the past year; the states have increased their output; I

believe that they have improved their methods of fish culture and of transportation; and if we could only get rid of the troublesome words "bacterium," "bacillus," "lymphosporidium," "micrococcus" or whatever it may be—these horrible things that cause tuberculosis, small-pox, furunculosis, and the Lord knows what—we would all feel much better, and we would be, and our work would be, far more successful. (Applause.)

PRESIDENT: The report of the secretary is next in order. No report has been filed except as contained in the printed proceedings of our last meeting. The report of the treasurer is next in order.

REPORT OF THE TREASURER.

GENTLEMEN:

I herewith submit my annual report as treasurer of the American Fisheries Society from September 21, 1908, to July 27, 1909:

RECEIPTS.

1908.		
Oct. 15.	H. M. Smith, return of award	$100.00
1909.		
Mar. 6.	S. F. Fullerton, electrotypes	2.50
June 26.	G. F. Peabody, error 1908 account	25.00
	Sale of Transactions	44.22
	Yearly dues	654.00
		$825.72

EXPENDITURES.

1908.		
Sept. 21.	Balance due treasurer	$42.45
Oct. 13.	Stamped envelopes	10.72
1909.		
Jan. 26.	G. F. Peabody, services of clerk	25.00
Feb. 26.	Goodwin & McDermot, stenographers	140.20
Feb. 26.	G. F. Peabody, reports and mailing	278.81
May 24.	Stamped envelopes	10.72
July 26.	G. F. Peabody, circulars, etc., and mailing	25.77
		$533.67
July 27.	Balance, cash on hand	292.05
		$825.72

Respectfully submitted,

C. W. WILLARD, Treasurer.

Toledo, Ohio, July 27, 1909.

Mr. Willard: In regard to the International Fishery Congress prize, the committee upon awards decided to withhold the prize, there being no paper presented which was thought to warrant an award. They accordingly turned the money back to the American Fisheries Society.

It is a source of great satisfaction to the treasurer to report a balance on the correct side of the ledger. Last year we had a deficit of about $50, the year before we had a small balance in the treasury, and four, five, and six years before that we had deficits all the way from $50 to $200.

Mr. Clark: I move that the treasurer's report be accepted and referred to the finance committee, and that the treasurer be complimented very highly for the excellent showing.

Motion seconded and unanimously carried.

President: The president desires to add his own appreciation of the good work of the treasurer. The auditing committee, which I think might as well be named now, will consist of Mr. Dwight Lydell, Comstock Park, Michigan; Mr. S. F. Fullerton, St. Paul, Minn., and Mr. S. W. Downing, Put-in Bay, Ohio.

We will now receive the reports of standing committees, and I will call upon the executive committee to report.

Mr. W. E. Meehan: I would like to ask for the postponement of that until a little later.

President: Any other standing committees to report?

Mr. Meehan: The committee on foreign relations, but I think you cannot get that report at present.

President: The committee on foreign relations cannot report until Mr. Titcomb arrives. He will have a report to make, but it will not be ready to present to this meeting, unfortunately. If there are no other reports of standing committees the next order of business is the appointment of committees.

The chair will appoint as a committee of five on nomination of officers for the ensuing year: Mr. S. W. Downing, of Put-in Bay, Ohio; Mr. W. H. Safford, of Conneaut

Lake, Pa.; Mr. Ward T. Bower, Washington, D. C.; Mr. W. P. Morton, Providence, R. I., and Mr. John E. Gunckel, Toledo, Ohio.

As to the committee of three on time and place of holding the next meeting, I would like to have some suggestions. I have two names I would like to place on that committee, but the third one is lacking. Two are Messrs. Meehan and Clark.

Mr. Burnham: I would like to name Mr. Frank M. Miller, of New Orleans.

President: The committee on time and place of meeting will consist of Mr. W. E. Meehan, Harrisburg, Pa.; Mr. Frank N. Clark, Northville, Mich., and Mr. Frank M. Miller, New Orleans, La.

The chair would like to defer the appointment of the committee on resolutions until the next session.

Before the papers are read, I think the committee on papers should arrange them, keeping in mind the fact that in the reading of papers preference is to be given to the authors who are present.

Mr. John E. Gunckel: You know that I am the only resident member in the city of Toledo. In corresponding with the president, Dr. Bean, and the secretary, Mr. Peabody, we made arrangements to meet here in September, for I have found, after being a commodore for a great many years that we could entertain you very nicely in the month of September. But after Mr. Peabody discovered that some of the fish hatchery people could not come here in September, the time of meeting was suddenly changed, with about 10 days' notice, to this date. That left me in bad condition to make arrangements to entertain you as fishermen should be entertained, our mayor being away, our yacht men all out, and our hook-and-line fishermen all busy. Fortunately, though, the Castalia Trout Club, which has a national reputation, came in and offered to take care of us on Thursday, and part of the reading of your papers or discussion of papers can be carried on in their building at Castalia.

I hardly think that I ought to sit down without thanking the Society for coming to our town. We have a fine growing city here, with a population of nearly 200,000, and I have maintained the reputation of the American Fisheries Society here, having been a member since 1890. I have never been accused of telling a fish lie that I could not prove. (Laughter.)

Now, I want to show you what I have learned these many years with respect to building up and doing for other people. I have practiced in my life something of what the world is beginning to recognize as wonderful—not what Gunckel has done, but what I have discovered—in taking the little boy of the street, the boy who has a bad reputation, the bad boy, the boy who grows up to be a man whom we do not want, the boy who annoys the Sunday school and day teacher. Eighteen years ago, soon after I became a member of this Society, I began to take up these little boys, until today I have a membership in the city of Toledo of 7,000, with a building costing $100,000, all paid for. I have a national association with 10,000 members and correspondents all over the world.

Now, if you have time, I would like to have you come up to the building at one o'clock any day that you are here and see those boys of the street in bathing, in the swimming pool, and spend a half-hour in looking at the building. You will not have to spend much of your time, and we will show you what we have. The other day I had 110 boys in bathing; for 5 of them it was the first bath they ever had. One of them had his clothes sewed on. Don't you laugh, because you have them in every city. You give one of my boys 25 cents and tell him to get change, and he will do so and give you correct change. They have found over $35,000 worth of property on the street and turned it in to me. While Mr. Willard was there yesterday a boy brought in a comb he had found on the street; and he glories in being placed on the roll of honor. So I should think you would appreciate that one of your members is trying what you are

trying to do, to prepare food for the future. I am trying to make good men out of bad boys. I hope to see you at our building today at noon when you adjourn, that you may see those boys and see how busy and how active they are. The floors are all filled with them, reading and studying. There is no lying, no swearing, no fighting. I have to tell them fish stories every now and then; and I have to be a member of this society in order to get truthful material. (Laughter.)

I have the pleasure of introducing Mr. George E. Pomeroy, one of our leading citizens and an active member of the Castalia Trout Club. But note this—not as a matter of record, however—no one of the Castalia Trout Club fellows ever invites me to their stream to fish. Why? Because they know that I will clean it out for them. (Great laughter.)

Mr. George E. Pomeroy, Toledo, Ohio: I certainly am very happy indeed to have you with us in Toledo. So far as the invitation to you to visit our club at Castalia is concerned, we have Mr. Clarence Brown here who has given attention to that matter. He was not here when I told Mr. Gunckel I would be pleased to explain the situation, but he has come in since, and I will ask him to give you the details of what we are offering you on Thursday.

Mr. Clarence Brown, Toledo, Ohio: Mr. President and Gentlemen: By direction of the President of the Castalia Club, I am here for the purpose of extending to your Society an invitation to visit the preserve of that club at Castalia, and I understand you have just accepted for Thursday of this week. We will arrange, if you can indicate something like the number, transportation from the hotel to the club grounds. The cars of the Lake Shore Electric Railway pass the door here, and they also pass through our premises. It is a run of about two hours. We have made arrangements to charter the cars necessary to accommodate you all, and we will be glad if you will fix the time when it will suit you to leave and the time when you desire to return. We can very easily take you down

there, spend a day at the club house, see the premises, and return you here safe, and I had almost said sober, in the evening, but the latter is not guaranteed. (Laughter.)

You will find there a stream that I am sure will interest you. You will find, I think, the most convincing evidence of the successful artificial propagation of trout in a stream in which there are no *fontinalis* naturally. They were planted there a number of years ago, and since that time we have conducted the propagation of trout until we have really one of the most remarkable streams in this or any other country, so far as artificial preserves are concerned. I will not guarantee that any of you can catch any fish, and yet I will guarantee that you can all equal Gunckel. (Laughter.) He was invited once, and visited the stream. He did not get a fish. (Laughter.) He has never been there since.

We are carrying on in that association a work somewhat similar to his. We are not trying to make good men out of bad boys, but we have been endeavoring, unsuccessfully, for many years, to make good boys out of bad men, and Gunckel is beyond the reach of our association. (Laughter.)

Now, if your association will kindly indicate your acceptance of our invitation, we will make all the necessary arrangements and do the rest.

I would first like to inquire, Mr. President, as to the number that can probably attend. If that can be ascertained, and we can be advised, we will make arrangements accordingly. Again I would like to know when it would suit your convenience to leave and return. Cars will be provided and await your pleasure, and we will also provide some automobiles for your entertainment at the club. We will show you the waters of that trout stream which rise in Castalia and flow off into Lake Emma; we will show you both of the clubs there, their hatcheries, and their method of raising and planting fish.

If I can have that information, I should be pleased to

make all the arrangements necessary to suit your convenience. (Applause.)

Mr. W. E. Meehan: I hope we will accept the invitation, but I would suggest Wednesday instead of Thursday. Usually we finish our business entirely by Thursday noon. Many of the members must go away about that time, and while it is possible that the meeting might be carried later than Thursday noon, it would be safer, I think, and insure a better attendance if Wednesday were decided upon rather than Thursday.

President: I take great pleasure in acknowledging the courtesy of your invitation, and all the more, because, if I remember rightly, it was in Ohio, in 1853, that the artificial breeding of brook trout began, with the experiments of Dr. Theodatus Garlick, of Cleveland. We have all heard a great deal about the famous Castalia stream, which is undoubtedly the finest stream in Ohio for brook trout, and the brook trout has been the first love of private fish culturists and public fish culturists since the time of Dr. Theodatus Garlick. It goes without saying that we are all interested in seeing a success such as yours. Therefore, we shall try to accept your invitation, and I will ask some of the members to immediately make such arrangements as are feasible, communicating with Mr. Pomeroy and Mr. Brown. I will ask Mr. Meehan and Mr. Fullerton to serve as a committee to take up this subject as soon as possible and let us know the result at the afternoon session.

Mr. Brown: Permit us to suggest, if it is thought desirable, that the Society visit the club tomorrow instead of Thursday. We can make arrangements, but we would like to know at the earliest possible moment, as our normal conditions do not provide for the entertainment of so large a number, and we shall have to make provision for your entertainment. I will communicate with the club by telephone and make arrangements for tomorrow, if it is thought desirable. I can do so as well as for Thursday.

FORTIETH ANNIVERSARY CELEBRATION.

PRESIDENT: The announcement can be made at the afternoon session, if that will be convenient.

There is a matter I would like to bring to your attention now, and that is the communication from Dr. H. M. Smith, Deputy Commissioner, Bureau of Fisheries, dated July 22. The communication is as follows:

The American Fisheries Society will soon reach the fortieth anniversary of its establishment, and it would seem proper that some recognition be made of this occasion and that a special program be arranged for an appropriate annual meeting.

If the matter seems to you to be feasible, will you please bring it to the attention of the Society for such action as it deems proper? I would suggest the appointment of a Fortieth Anniversary Committee, with full powers to determine the program and special exercises for that meeting, to solicit funds, and to do all other things that are considered necessary, provided the Society is involved in no unauthorized financial obligations.

MR. FRANK N. CLARK: I move that such committee be appointed.

PRESIDENT: The committee on time and place of meeting consists of Mr. Meehan, Mr. Clark and Mr. Frank M. Miller. With this communication before me, and with another, from the director of the New York Aquarium, I shall be glad if they will discuss the whole subject. Mr. Townsend's letter, dated July 23, is as follows:

It is fourteen years since there has been a meeting of the American Fisheries Society in New York City, where a meeting was held in the New York Aquarium on June 12, 1895.

I hereby extend an invitation to the American Fisheries Society to make its next place of meeting in The Aquarium.

I feel sure that the New York Zoological Society, the Museum of Natural History, and the city and state angling associations will be interested in the matter and that a meeting in New York can be made interesting to the members.

Hoping that you may be willing to recommend this proposal to your committee, I remain, etc.

PRESIDENT: You are aware, of course, that the American Fish Culturists' Association, now the American Fisheries Society, was founded in 1870, chiefly through the instrumentality of Livingston Stone, a revered member of this Society, and that Mr. Stone was ably seconded in New York by Robert B. Roosevelt, one of the first fish commissioners of the State of New York. The meeting took place in New York, and it would therefore seem to be historically interesting if the fortieth anniversary meeting could also be held in New York.

MR. CLARK: Is the next our fortieth meeting? I think that this is the thirty-eighth. The program so states.

PRESIDENT: The Society was organized in 1870 during the same year that there came into existence the Deutscher Fischerei Verein, and just the year before the United States Fish Commission was established. That is what I find in the records, not in our records, but in the general records of the history of fish culture. If I am wrong I should be glad to be corrected, but if that be true, as I believe it is, because it is published in the state reports of New York, published also by Mr. Clark in his review of fish culture, in the Manual of Fish Culture, and elsewhere—in fact, you can find it in almost any historical account of the beginnings of fish culture in the United States—if that be true, 1910 will be our fortieth anniversary, and it remains for the committee to consider these matters and to decide whether New York be named as the place of meeting.

MR. CLARK: Do we understand that the committee on time and place of meeting shall take this matter up also?

PRESIDENT: No; I would like to have a motion to appoint a special committee.

MR. CLARK: I move that a committee such as Dr. Smith suggested be appointed.

MR. FULLERTON: We should revise our records. Our notice says this is the thirty-eighth meeting. The matter should be set right.

Mr. Meehan: That can be arranged by this special committee.

President: It is a matter to be investigated, because the American Fish Culturists' Association was certainly created in 1870.

Mr. Clark: I think that is right. If it is in order, I will state my recollection of the matter. I was not there at that time, however, I was engaged in fish culture. My recollection of the matter, and I think it can be traced in our proceedings 20 or 25 years ago, is that Mr. Stone gave a short paper on the history of the American Fisheries Society and the American Fish Culturists' Society. Now, as I remember, a few gentlemen, including Mr. Stone and Mr. Roosevelt, met in a room of some fish association in New York and organized at that meeting—merely organized—what is now the American Fisheries Society; and I think our president is right in saying that that organization took place in 1870. However, they did no business to amount to anything, any further than organizing, and the next year they had their meeting, and undoubtedly this thirty-eighth meeting that we now have on our program is taken from that. I think that is where the mistake is, but I do think that Mr. Stone, Mr. Roosevelt, and Dr. Hudson and eight or ten others organized the American Fisheries Society in 1870.

President: I have a reference to Mr. Stone's review of fish culture in the United States, if I can find it. I can tell later what Mr. Stone said about it.

Is the committee on papers ready to report?

Mr. Meehan: Is not there a motion before the meeting to appoint a committee?

Mr. Clark: I moved that this special committee be appointed.

President: There are two committees to be appointed, one on resolutions and one special anniversary committee.

Mr. Clark: That motion has not been passed.

PRESIDENT: The motion is to appoint a special committee on the fortieth anniversary of the American Fisheries Society, a committee of five.

Motion seconded and unanimously carried.

PRESIDENT: The motion was made by Mr. Clark, and I will ask him to serve as chairman of that committee.

MR. CLARK: I suggest that you take some time and not appoint that committee now.

PRESIDENT: It is a little difficult to appoint such committees offhand.

MR. CLARK: There is nothing for that committee to do at this meeting, and the chair may appoint it the very last thing.

PRESIDENT: Yes, but I am sure that I shall want Mr. Clark as chairman of that committee. We will now hear the report of the committee on papers.

MR. JOHN E. GUNCKEL: We have taken the articles as they appeared, and we give preference to gentlemen present to read their papers. We have dovetailed the articles, as to subjects, and Mr. Stevenson will read the order in which they will be taken up pursuant to the recommendation of the committee. They will be read this afternoon, and will continue with a night session or tomorrow according to your pleasure.

MR. CHARLES H. STEVENSON: The list of papers that the committee has prepared for presentation this afternoon is the following:

Dr. Tarleton H. Bean, A Plea for the Systematic Study of Fish Diseases.

Mr. W. E. Meehan, Some Recent Experiments in Sturgeon Culture.

Mr. Ward T. Bower, Notes on the Increase in Size of Fish Ova after Water Hardening.

Mr. Charles W. Burnham, Notes on the Yellow Bass.

Mr. Andrew Price, The Economic Value of the Sportsman.

Mr. Charles H. Stevenson, The Fishery Census of 1908

The committee will make further report on papers to be presented later.

The report was accepted.

PRESIDENT: We will proceed with the miscellaneous business.

The matter of the visit to the Castalia Club preserve having been brought up and discussed at length, it was voted to start from the hotel at 8 o'clock a. m., July 28, on the special car provided by the club.

A recess was then taken until 1.30 p. m.

Afternoon Session, July 27, 1909.

The meeting was called to order at 2 o'clock.

PRESIDENT: The committee on the reading of papers has made a preliminary report, and the order of the papers for the afternoon has been determined on.

MR. JOHN W. TITCOMB: I would like to make an announcement. A few days ago my attention was called to a weed cutter manufactured by Aschert Brothers, of Milwaukee, Wisconsin. I do not know anything about this cutter, but if it is what the circular says it is, it is something that the fish culturists want, especially those engaged in pond culture. So I wrote to the firm and asked them to have it here, and be ready to demonstrate it, and one of their representatives has come. Moreover, I have been informed by a member of the Castalia Trout Club that the club will be glad to see a demonstration of this machine tomorrow at the preserve, and I therefore ask that Mr. Aschert go with the Society tomorrow morning at 8 o'clock, and have his cutter at the club grounds ready for demonstration. The circulars with reference to it are on the table.

The six papers previously announced, by Dr. Tarleton H. Bean, Mr. W. E. Meehan, Mr. Ward T. Bower, Mr. Charles W. Burnham, Mr. Andrew Price, and Mr. Charles H. Stevenson, were then presented. The papers and the discussions are printed in the second part of the proceedings.

Mr. John W. Titcomb: I would like to ask whether there are any persons here who have papers of their own. It seems to me they should have the first chance to present them.

President: The committee on program has given me these six papers, and had before it a large number of papers, which are here on the table, but I believe not one of the authors of the papers which are here is now present. There are, however, papers by Mr. Seymour Bower, Mr. John E. Gunckel and Mr. Frank N. Clark, but the committee passed on those papers, consulted with the authors, and I am told these gentlemen are not quite ready for presentation. For that reason we go on to the first paper by an absent member.

Mr. Titcomb: My only object was to give those who are here an opportunity to read their papers first.

President: I would like to ask Mr. Seymour Bower, if he is present, whether there is a question box?

Mr. Seymour Bower: There was a question handed to the committee, and I turned it over to Mr. Stevenson.

Mr. Meehan: There were four questions.

Mr. Stevenson: The committee thought there might be a number of questions in the question box, and that it would be better to defer the matter.

report of the executive committee.

President: I will call for the report of the executive committee, Mr. Meehan, chairman.

Mr. W. E. Meehan: The unanimous report of the executive committee is as follows:

The executive committee has the honor of making the following report of its work during the year.

Early in the present year your chairman received word from the president, Dr. Bean, and Dr. Henshall, that there was some difficulty in making suitable arrangements for holding the annual meeting of the Society in the Yellowstone Park. It was suggested, under the circumstances, that the committee designate another meeting place. A vote of the committee indicated a majority for Toledo. The president, Dr. Bean, and the secretary, Mr. Peabody, were notified of the change and preparations made for holding a meeting at Toledo, Ohio.

The committee was advised by Dr. Hugh M. Smith and the president that Mr. Charles H. Stevenson, of Washington, had suggested the establishment by the Society of a fund, the interest of which should be used for procuring a medal or giving a cash prize periodically to the person making the greatest achievement in fish-cultural work or the greatest achievement along such lines. The committee unanimously recommend that should any moneys be contributed for that purpose they be accepted and that such moneys be set apart and invested for the purposes suggested. During the discussion on this important subject the question arose as to whether or not the American Fisheries Society is an incorporated body, and if not, whether such a fund could be properly created and established. This committee, therefore, strongly recommends that if the American Fisheries Society is not incorporated steps be taken for incorporation, and a fund of the character named established as soon as possible.

The committee reports with sorrow the death of the following members:

Walter L. Powell, Harrisburg, Pa., in March, 1907. Mr. Powell was one of the early members of the Pennsylvania Fish Commission and for several years was its treasurer.

Westley S. Henry, Park Side, Pa., in September, 1908. Mr. Henry was a member of the Paradise Valley Brook Company, and its treasurer. He was also well known throughout Pennsylvania as the proprietor of a large hotel in Monroe County, the headquarters of thousands of anglers of Pennsylvania and New York.

Redfield Proctor, United States Senator from Vermont, on March 4, 1908.

R. D. Hume, San Francisco, Cal., in November, 1908. Mr. Hume was one of the pioneer fish culturists on the Pacific coast. It was he who demonstrated the practicability of artificially propagating salmon on the Rogue River.

A. Starbuck, Cincinnati, Ohio, in 1908. Mr. Starbuck was well known in Ohio as a propagator of gold fish.

L. D. Huntington, New Rochelle, New York, in April, 1909. Mr. Huntington was president of the Society in 1895-6.

The executive committee recommends that the above names be sent to the committee on resolutions for suitable action.

On motion duly seconded the report of the executive committee was adopted.

Mr. Meehan: I wish to make some remarks with reference to the question of the incorporation of the society and with reference to this fund, more than could be put in a report of that kind. Whether you decide that it shall come up later or come up now, I should at some time like to speak on the question.

PRESIDENT: That is subject to motion. Do you wish to discuss that phase of the committee's report now? The report has been adopted.

MR. MEEHAN: But there is a recommendation in that report in regard to the incorporation of the Society and the establishment of a fund, the interest of which would be used for prizes or for medals, or something of that sort. The mere adoption of that report carries with it, of course, the question of doing this, and shows that the Society approves it, but it will require further action of this body to carry anything of that sort into effect. The question in my mind then is whether it is germane to take it up now or to take it up later.

PRESIDENT: That rests with the Society. What will you do about this matter?

MR. TITCOMB: I move that that portion of the executive committee's report relating to the awarding of prizes and matter relevant to the incorporation be referred to a committee consisting of the incoming president, secretary, and treasurer of the Society with power to act.

MR. MEEHAN: We might add to that committee, with Mr. Titcomb's approval, the chairman of the incoming executive committee, on account of the general business of the year.

MR. TITCOMB: That is accepted.

The motion was seconded and unanimously carried.

PRESIDENT: We will hear the report from the auditing committee, which will be read by the secretary.

ACTING SECRETARY: The auditing committee's report is as follows:

> We have examined the report of the treasurer, together with vouchers, and find the same correct.
>
> DWIGHT LYDELL,
> SAM. F. FULLERTON,
> S. W. DOWNING,
> Committee.

The report was adopted.

PRESIDENT: We will now hear the report of the committee on foreign relations.

MR. TITCOMB: The chairman of the committee on foreign relations is not here, but he wrote me stating that he will have the report ready in time to print. Some of the matter prepared by that committee, especially its chairman, is quite interesting. Therefore, I suggest that if he has it ready in time it be printed as part of the transactions of this Society.

PRESIDENT: It is moved that the report of the committee on foreign relations be printed as part of our transactions if received in time for the printer.

The motion, seconded by Mr. Meehan, was unanimously carried.

MR. MEEHAN: I would like to announce that immediately after adjournment this afternoon, the committee on time and place of meeting will convene here at the officers' desk to hear suggestions for place of meeting. This committee consists of Messrs. Meehan, Clark, and Frank M. Miller.

PRESIDENT: The committee on papers is Mr. Gunckel, Mr. Seymour Bower, and Mr. Stevenson, and I would like to ask that committee to examine the papers which still remain and return them to the Society in the order for reading, if any of them are to be read.

The committee on resolutions has not yet been named, I believe, and the committee on the fortieth anniversary meeting has not been named. The chair would like to announce the committee on resolutions. He is not prepared as yet to name the other committee. The committee on resolutions is as follows: Mr. John W. Titcomb, Washington, D. C., chairman; Mr. S. F. Fullerton, St. Paul, Minnesota; Mr. W. E. Meehan, Harrisburg, Pa.; Mr. Seymour Bower, Detroit, Mich., and Mr. Dwight Lydell, Comstock Park, Michigan.

MR. TITCOMB: I move that the papers be referred to the committee on program, and that we have an evening session; and I suggest further that the committee assign some par-

ticular hour when matters relevant to pond culture may be discussed. I do not know whether there are any papers on that subject, but it is an interesting one, and all those who desire should have an opportunity to discuss it. It seems to me that we ought to have a time set apart for this when all of those posted on the subject should be present, in order to bring out all the information possible.

Mr. Meehan: I suggest also that should there be in the question box any questions relating to pond culture, they be brought forward at the same time.

Mr. Clark: I wish to state that I have prepared no paper on the subject given in the program. The announcement is a mistake.

Mr. Gunckel: When Mr. Peabody was here, he said he put me down for the subject which you will see on the program, and he said, "If we have enough papers you won't have to read yours." (Laughter.) Now, I have discovered a sufficient number of papers to have a discussion as long as you stay in this town, but I will tell you what I would like to have you do. It would be no trouble for me to prepare a paper, even if I had to leave you ten or fifteen minutes for that purpose. If I prepared a paper I would get through in thirty minutes. Now, if on Thursday you will adjourn here at 1 o'clock and come out to the newsboys' building at that time, stay ten minutes, and see 100 boys in bathing, some of them that never had a bath before, and five minutes to look through the building, and five minutes to get back here, that is half the time we would spend in reading a paper. If you will do that Thursday, I think you will discover something of interest, and when you go to your home you will say, "Well, there are other things besides fishing." I would like to have you consider that, but if you want a paper I can get off into a corner and figure one out very quickly. (Laughter and applause.)

Mr. Titcomb: We will probably all go to Castalia tomorrow, and I suggest to the committee that the subject of pond culture and all matters relevant to it be discussed there.

But I cannot close without suggesting also that after Mr. Clark reads his paper on "What is a Fingerling," Mr. Gunckel read a paper on "Why is a Carp." (Great laughter.)

PRESIDENT: I think Mr. Clark and everybody else will admit that it is no joke to raise fingerlings, even if fingerling be a joke.

The Society then adjourned until 7.30 p. m.

Evening Session, July 27, 1909.

The meeting convened at 7.30 o'clock.

PRESIDENT: The committee on the fortieth anniversary will be Mr. Charles H. Townsend, director of the New York Aquarium, chairman; Mr. Frank N. Clark, Northville, Mich.; Dr. Hugh M. Smith, Washington, D. C.; Mr. W. E. Meehan, Harrisburg, Pa., and Mr. George P. Slade, president of the South Side Sportsmen's Club, Long Island, New York.

MR. CLARK: Would it not be better to offer some name instead of mine?

PRESIDENT: The president does not think so.

MR. CLARK: It occurred to me today, after I made the motion and you very courteously appointed me as the chairman of that committee, or said you were going to, that it was very kind in you, but perhaps the members of that committee should be mostly New York men. Now if you are sure you have not enough on there for that purpose, I do not wish to shirk any duty.

PRESIDENT: We have one western man, Mr. Clark, four eastern men, one from Washington, one from Philadelphia, and two from New York. I might say further that although not identified with the committee, I shall do all in my power personally to aid to make the fortieth anniversary meeting a great success.

MR. MEEHAN: As one of the members appointed on that committee I hope you will see that Mr. Clark's name is re-

tained there. Mr. Clark has been a constant attendant at the American Fisheries Society for a quarter of a century, and has not missed a meeting in that time. His experience in making arrangements would be invaluable to the committee, and I think Mr. Clark by all means ought to be a member.

PRESIDENT: I agree with you. I want to read a little paragraph in a letter from Dr. Smith, who wrote to me and to Mr. Willard on this subject. I think this paragraph has been incorporated in the resolution under which this committee has been appointed.

> I would suggest the appointment of a fortieth anniversary committee, with full powers to determine the program and special exercises for that meeting, to solicit funds, and to do all other things that are considered necessary, provided the Society is involved in no unauthorized financial expense.

I believe that is incorporated in the resolution so that this committee is charged with the duty as defined in that part of Dr. Smith's letter.

MR. TITCOMB: May I ask as to whether that will authorize the committee to incur the expense of postage up to say $20 or something like that?

PRESIDENT: I think the committee might as well be instructed now as at any time on that point.

MR. TITCOMB: I move that the committee be authorized to incur an expenditure for postage in an amount not exceeding $20, and furthermore, that the committee be authorized to edit and prepare a special commemorative edition of the transactions, if that is not included. What I mean is, that this committee shall have the arrangement of the publication of the transactions in this particular instance.

PRESIDENT: I think that was intended to be covered in this sentence, "with full power to determine the program and special exercises, solicit funds, and do all other things that are considered necessary."

MR. TITCOMB: Ordinarily that would refer to the arrangements and management of the meeting, and would

not refer to the publication of the transactions afterwards. I would like to see my suggestion incorporated and have it fully understood, and I make it as a motion.

PRESIDENT: It is moved that $20 be authorized to be expended as postage, and that the anniversary committee also be authorized to edit the papers and see that they are properly printed.

MR. MEEHAN: Before that is put—it meets my fullest approval—it seems to me there is another question that might arise to make it advisable to add another phrase. This committee is to make all arrangements, and is authorized to make arrangements for the program for this meeting. Now, such a program should be published beforehand and sent to the various members of the Society. That would necessarily entail an expense, not a large expense to be sure, but it seems to me that perhaps a little more might be added so as to cover the authorized expenditure for the printed program for this meeting. You now cover postage and correspondence. The committee will be authorized to prepare a program, but it is not authorized to print that program.

MR. TITCOMB: Your idea is that this committee should prepare that program instead of the secretary?

MR. MEEHAN: Naturally, it says so.

MR. TITCOMB: Then I should think that instead of limiting it to $20 they be authorized to make the necessary expenditure for postage, preparation and printing of program, etc.

PRESIDENT: Do you think that this is not sufficient authority for the committee "to determine the program, special exercises and solicit funds." What are these funds for except for the necessary purposes to which you refer?

MR. S. F. FULLERTON: This $20 doesn't look good to me —limiting the committee to $20. If the committee is going to do the secretary's work and send out circulars and programs for the meeting, it ought not to be limited to $20.

MR. TITCOMB: I accept that amendment.

Mr. Fullerton: We should take the money from the treasury.

Mr. Meehan: Then the funds solicited should go into the treasury.

Mr. Fullerton: Before the original motion is put I think another clause should be added. The committee should work in harmony with our secretary in regard to this, because a lot of matter will come to him that would not go to the committee.

Mr. Titcomb: I think the committee should have the editing and publication of the transactions.

President: Was not that included in your motion?

Mr. Titcomb: That is intended.

Mr. Fullerton: The secretary should be consulted.

Mr. Titcomb: Of course.

The motion as amended was unanimously passed.

Mr. Stevenson: Before proceeding to the reading of papers, I wish to say that our esteemed secretary is lying critically ill in Chicago, and I move you, sir, that our acting recording secretary be directed to send a telegram of sympathy to Mr. Peabody at the hospital in Chicago.

The motion was seconded and unanimously carried by a rising vote.

Mr. Titcomb: I suggest that the committee on resolutions prepare that resolution.

Mr. Clark: I suggest that it be sent tonight, and under the acting secretary's name.

So agreed.

President: We will now hear the report of the committee on nominations.

Acting Secretary: The chairman of the committee on nominations has requested me to make the following announcement:

For President, Mr. Seymour Bower, Detroit, Michigan.

For Vice-President, Mr. W. E. Meehan, Harrisburg, Pa.

For Recording Secretary, Mr. George F. Peabody, Appleton, Wisconsin.

For Assistant Recording Secretary, Mr. Ward T. Bower, Washington, D. C.

For Corresponding Secretary, Mr. Charles G. Atkins, East Orland, Me.

For Treasurer, Mr. C. W. Willard, Westerly, R. I.

For Executive Committee:

Mr. S. F. Fullerton, St. Paul, Minn., chairman.
Mr. C. H. Stevenson, Washington, D. C.
Mr. C. H. Townsend, New York City.
Mr. G. H. Lambson, Baird, California.
Mr. George T. Mathewson, Thompsonville, Conn.
Mr. Frank Miller, Put-in Bay, Ohio.
Mr. Jabe Alford, Madison, Wisconsin.

Mr. Clark: I move that the report of the committee on nominations be accepted and adopted.

The motion was seconded and unanimously carried.

President: This carries the election of these members.

Mr. Titcomb, chairman of the committee on resolutions, then presented the following telegram to be sent to the secretary. The message was approved and directed to be sent:

Mr. George F. Peabody,

Presbyterian Hospital, Chicago.

The American Fisheries Society extends sincere sympathy to you, and prays for your speedy recovery.

Ward T. Bower,
Acting Secretary.

President: The next order of business is the reading of papers, and we will now hear a paper on "Some Details of Salmon Culture," by W. O. Buck, Grand Lake Stream, Me.

Mr. Buck's paper was then read, and was followed by a paper by Mr. John N. Cobb, on "The King Salmon of Alaska," and by a paper by Mr. Seymour Bower, on "The Rainbow Trout in Michigan," all of which, with the discussions, appear in the second part of the proceedings.

Mr. Pomeroy: We would like to have it understood as to the car. Of course we cannot hold the car, but it will be

ready at 8 o'clock in front of the Secor Hotel and will bring you back here to the house; so if you will all be ready as promptly as possible it will oblige us. We probably can hold it a minute or possibly two minutes, but not much longer. Everything is arranged to change the date from Thursday to Wednesday morning at 8 o'clock.

Mr. C. W. Willard: Will you instruct us what car to take in case any should be late?

Mr. Pomeroy: If you will get a Lake Shore Electric time card it will show you what car to take to go through to Sandusky. It is the Sandusky car on the Lake Shore Electric that you must take. I believe that the 9.30 car would take you through, but there will be no trouble at all in getting from the porter in the house a little time card for that road.

Mr. Willard: At what station do they get off?

Mr. Pomeroy: Castalia. It is right in our grounds. The car will stop for you there. There will be no difficulty in locating the site, and you get off at the upper part of the grounds. There is a foot bridge across every stretch of water, so that you can walk through to the clubhouse in six or seven minutes, if you chose to come straight, or if you follow either stream you will reach the clubhouse.

The Society then adjourned.

Castalia, Ohio, July 28, 1909.

Meeting called to order by the president at 12 o'clock noon.

President: There are two committees to report, one, the committee on the fortieth anniversary, whose report we will now hear.

Mr. W. E. Meehan: We were a little embarrassed. There were two propositions made, or rather two invitations extended, one for us to go to New Orleans, and the other to New York. Those who advocated New York did so on the ground that the next meeting would mark the fortieth anni-

versary of the life of this Society. The other invitation from Louisiana was couched in such cordial terms, and the reasons given were so strong, that the committee felt embarrassed, but has finally decided to report in favor of holding the meeting in New York at the Aquarium, to mark the fortieth anniversary, and in the last week in September, beginning on Tuesday. The committee strongly recommends that the Society at its next meeting take action toward having the following annual meeting held at New Orleans, Louisiana.

Mr. Clark: I move that the report of the committee be accepted and adopted.

Mr. Fullerton: Does that include the recommendation for New Orleans?

Mr. Clark: It does, so far as we have power. The Society cannot this year, of course, positively set the time of the meeting for 1911, but it can adopt the committee's recommendation. That does not necessarily put the meeting in New Orleans.

Mr. Meehan: We simply recommend that the place be considered next year.

The motion was unanimously carried.

Mr. Meehan: I think we should like to hear a few words in reference to Louisiana.

Mr. Frank M. Miller: Not much more can be said by me than what has been so eloquently said by the distinguished chairman of the committee. I think myself that the time has come for the American Fisheries Society to be true to its name. Here you are a lot of eastern, northern and western men. Probably Mr. Burnham and myself are the only southern men here. The south is a great country, increasing enormously in its resources, and it has been neglected by the rest of the country; but we are now waking up to the fact that we are a part of you, and we want brotherhood with you that we may secure our common ideal of making this the greatest country on the face of the earth. (Great applause.)

Our state is now waking up to the fact that the natural resources which we possess in great quantities have been shamefully abused. This is the first year that we have ever had any restraining hand upon our people, and some of them don't like it. But nevertheless, the natural resources of the State of Louisiana are almost fabulous, and we want you to come down and see them.

As far as fish are concerned, with singular fatuity we have turned over the conservation of the fish to the Dago, the most undesirable citizen we have, a curse to any community. He will eat anything from a mouse to a dog, and from a mocking bird to a buzzard. He has seined the waters of the Gulf with seines that will catch a mosquito, and the fishing industry of our state has been shamefully neglected.

Now, we on the Gulf front have awakened to the fact that something must be done, and we think it should be done through the American Fisheries Society.

If you come down there in 1911 our governor will invite the governors of the other Gulf States to come themselves and send representatives, and we will have a convention worth while. I can assure you that we will give you all a very excellent time.

New Orleans is a beautiful city. It is not an American city; it is somewhat foreign. But nevertheless you ought to see our city, ought to see our state, and I bespeak on the part of the State of Louisiana the most cordial invitation to you to come there to hold your convention in 1911. (Great applause.)

PRESIDENT: Mr. Miller, I do not believe that the members of this Society require any argument to prove what you have said to them, because they know from their own personal observations that the southern waters are richer today in the fish which we love than are the northern waters. The finest fish that take the hook or leap to the fly are in the southern waters; the best oysters that I ever ate I have eaten in New Orleans; and I understand that the little-neck clam also is found within the jurisdiction of the State of Louisiana; and

there isn't any doubt about what can be done with the littleneck clam in Louisiana when Miller and his associates get hold of the problem. I am very glad, indeed, to second the action of this Society as far as I am able to do so. I would like to go to New Orleans again and again.

MR. MILLER: I thank you.

REPORT OF COMMITTEE ON RESOLUTIONS.

PRESIDENT: Is the committee on resolutions ready to report?

MR. TITCOMB: The committee has the honor to report the following resolutions:

RESOLVED, That the thanks of this Society be extended to Mr. John E. Gunckel, of Toledo, Ohio, the friend of the bad boy, the patron of the good fisherman, for the successful manner in which he has dealt with the difficult details connected with holding our convention of 1909, and the Society, in grateful acknowledgment of his efforts, offers to furnish him indefinitely with the underlying facts upon which to base his future literary triumphs in piscatorial narration.

RESOLVED, That the American Fisheries Society, appreciating the pleasure and profit derived from the opportunity of visiting this club house, grounds and trout stream, most heartily thank the Castalia Trout Club, its officers and members, for the privilege of enjoying their hospitality.

WHEREAS, As silently as the clouds obscure the sun and shut out the rays which brighten our days, so does the grim reaper whom, for want of a better name, we call Death, gather his harvest of those whose companionship in the Society has brightened our meeting and whose work has done so much to help along the cause we are all enlisted in. Little is the space that anyone fills in the world, yet it was the labor of such men, whom we will sadly miss, that made possible something which without them we would still be groping for.

RESOLVED, That we shall miss our deceased brothers whose names follow, and in our sorrow we feel for those who were nearer and dearer, to whom we extend our sincerest sympathy:

Walter L. Powell, Harrisburg, Pa.
Westley S. Henry, Park Side, Pa.
Redfield Proctor, United States Senator from Vermont.
R. D. Hume, San Francisco, Cal.
L. D. Huntington, New Rochelle, N. Y.
Alexander Starbuck, Cincinnati, Ohio.

The report of the committee was approved, the first two resolutions being unanimously carried, and the last resolution being adopted by a rising vote.

Mr. Titcomb: The committee offers the following additional resolution:

> There shall be a standing committee of three to be appointed annually by the president, to be known as the editing committee. The committee shall have power to pass upon all papers presented and decide whether they shall be published in the proceedings of the Society, and shall also have power to edit the report of the discussions before publication. The committee shall also have power to edit any paper which it may consider worthy of publication, but which is not in literary form. When the work of the committee is completed the manuscript is to be turned over to the secretary for publication. Any papers rejected are still the property of the Society and are to be filed by the secretary.

If I may be allowed to add a word in this connection: The editing of papers which contain good stuff, as an editor might call it, I think should encourage practical men, and many of us have not had the advantage of a college education. This resolution really should encourage the practical fish culturists to present to us more material than they do today. They hesitate about it now, because they fear that it will not be presented in proper shape. Here they have an opportunity to do it through a committee who will put it in proper shape before it is published.

Mr. Clark: I move the adoption of the resolution.

Dr. Evermann: I would suggest instead of the name "editing committee" that you call it "committee on publication."

Mr. Meehan: It is not a committee on publication. The publishing is done by the secretary of the Society. This is purely an editing committee.

Dr. Evermann: It seems to me the name committee on publication would cover the whole ground. Slips may be made between the secretary and the committee very easily. The committee should consider not only the literary form, but matters of fact and also points of good book-making.

President: I would like to say from my personal ac-

quaintance with editorial work that it is going to be rather difficult to find a committee that will be able to do this work. The secretary has done it heretofore, and every one knows it is not a light matter. However, that will have to be considered in the selection of the committee. It will always be a live proposition to find a committee that will really do the work. It is no very easy matter to get publications in print properly.

Mr. Seymour Bower: Am I to understand that the secretary is to submit the proofs the same as usual, or is the action of the editing committee final? Would authors have no opportunity of making corrections themselves? I think that the proofs, both of the discussions and papers, should be returned to the authors, because this editing committee, while it would polish up and put in nice form, might unwittingly change an idea and convey a wrong impression.

Mr. Titcomb: It is my understanding, after conferring with the other members of the committee, that following the revision the matter would go to the authors, that is, any minutes of discussion, if they are to be edited at all, of course, should be edited before they go to the author or speaker, so that he may have a chance to see whether he has been misrepresented and may make necessary corrections.

President: I of course assume that this committee will act just as any other editor would act, submitting proofs to the authors and incorporating any necessary corrections that they may indicate.

Mr. Meehan: That is my idea—it should naturally go back to the author.

The resolution as amended, being acceptable to the committee, was adopted.

President: I will name this committee later.

Mr. Meehan: I move that we take a recess subject to the call of the president.

This motion prevailed, and a recess was taken until 3.10 p. m., when the meeting was called to order.

President: Before we begin the consideration of the

papers, I will announce the committee on publication: Dr. Hugh M. Smith, chairman; Mr. W. E. Meehan, and Mr. Ward T. Bower. I suppose a committee of three will be large enough.

Mr. Meehan: Don't you think you had better have all three members men from Washington? I do not say this to shirk work.

President: I wanted to have the benefit of Mr. Meehan's editorial experience. Mr. Meehan has been the editor of an important daily paper for so many years of his life, besides having distinguished himself in other literary fields, that I should be sorry to miss his guidance with this committee; and I name Dr. Smith, because it is through Dr. Smith that this necessity was first brought to the attention of the Society. Then Mr. Bower, being our assistant secretary, would naturally perform the work which would otherwise go to the recording secretary.

Mr. Meehan: I am ready to do anything that the Society wants me to, but if you had three men in Washington they could work conveniently together.

President: The committee will stand as announced.

I do not know of any other business except the reading of papers. Since the meeting of last evening a paper has been received from Prof. Ward. I will read to you the full list of papers that remain to be considered, and will ask you to decide which of them shall be read:

Dr. S. P. Bartlett, The Future of the Carp.

Mr. John L. Leary, The Propagation of Crappie and Catfish.

Mr. Felix A. Laumen, Some Essentials in Pond Culture.

Mr. S. G. Worth, Progress in Hatching Striped Bass.

Mr. G. H. Thomson, Protection of the Undersized Trout.

Prof. H. B. Ward, The Leaping of the Alaska Salmon.

Mr. A. Kelly Evans, The Awakening of Public Interest in the Improvement of the Fisheries of the Province of Ontario.

This last paper, by the way, has not yet been received, and

consequently cannot be considered, except that we might have a vote to publish it if received in time for publication. The first paper on the list is Dr. Bartlett's, the next Mr. Leary's, the next Mr. Laumen's, followed by Mr. Worth, Mr. Thomson and Prof. Ward.

MR. CLARK: I move that we take up the questions in relation to pond culture, and the papers in that line first.

The motion was adopted. The first paper on pond culture being that of Mr. Leary, it was read by the assistant secretary and was discussed. The paper by Mr. Laumen was next read by the assistant secretary. These papers appear in the second part of the proceedings.

PRESIDENT: The only papers remaining on the program are those by Dr. Bartlett, Mr. Worth, Mr. Thomson, and Professor Ward.

MR. CLARK: I move that the remainder of the papers be read by title, and considered read and be published in the proceedings.

The motion was carried.

The Question Box was then taken up. The questions considered and discussed will be found at the end of the papers and discussions.

MR. CLARK: Mr. Brown, of the club, has requested me to ask when it is desired that the special car go back. It can go back any time that the Society sees fit.

PRESIDENT: I cannot see any reason why our proceedings should not be finished by 4.30. It appears that we can finish the Question Box, install the new officers, and do all that remains to be done by 4.30.

MR. CLARK: Then I will tell Mr. Brown that is the wish of the Society.

PRESIDENT: I take this opportunity to thank you for having endured my ministrations during the past year. One of the greatest pleasures after taking up a responsibility is laying it down, which I do with great cheerfulness under the circumstances, because I know that my old and esteemed friend, Mr. Seymour Bower, will take up the work and

prosecute it with greater vigor and no doubt more discretion than I have been able to exercise. It was said by a very eminent humorous poet that

> Men dying make their wills,
> But wives escape the work so sad;
> Why should they make what all their lives
> The gentle things have always had?

Speaking about dying, which, of course, the present officers are about to do, some of us have an old western feeling that if we must die we prefer to die with our boots on. Now, thanks to the generosity and kindness of our treasurer, who is not here, I am able to die with my boots on. You can see for yourselves. (Laughter.) (The president here referred to a pair of toy rubber boots.)

I now have the pleasure of asking Mr. Clark to induct the president-elect to the chair.

Mr. Clark: Mr. President, as long as 29 years ago, when our late Professor Baird, the founder of the fish-cultural work of the national fish commission, asked me to take hold of the work in Michigan, plans were formed for taking it up permanently at Northville. At that time we had diseases among our fish, and I made up my mind that we must have some one connected with that work who would be able to doctor them. Knowing that the United States Fish Commission at that time did not have money enough to employ a trained physician, I looked about for the next best man to help me, and I engaged a druggist, Mr. Bower, to help start the work at Northville 29 years ago the first of September, and from that time on he has done practically nothing but fish-cultural work. I do not wish to take the credit. I simply picked him out as a fish doctor; but, Mr. President and gentlemen of the Society, I builded better than I knew. He was not a fish doctor, but he has turned out to be one of the best fish-culturists in the world today. (Great applause.) And I now take pleasure, Mr. President, not in introducing him, but in inducting Mr. Bower to the office

and chair of the presidency of the greatest society, to my mind, in the world, the first state superintendent (I think I speak advisedly) ever elected to preside over the American Fisheries Society. Mr. Seymour Bower, gentlemen. (Great applause.)

REMARKS OF NEWLY ELECTED OFFICERS.

Mr. Seymour Bower: Mr. President, and gentlemen of the Society, if I would ordinarily feel greatly embarrassed on an occasion of this kind, I certainly feel doubly so after what Dr. Bean and Mr. Clark have said. I feel so embarrassed, in fact, that I heartily wish that this part of the program might be omitted. I am free to say that I do not enjoy this stage of the proceedings even a little bit, because I am not built that way, and yet I do want to thank each and every member sincerely and feelingly for the expression of confidence conveyed in your choice of an official leader for the ensuing year.

During my life I have belonged to, or rather have been identified with, several orders and organizations, but I can truthfully say that the one that I have learned to love better than any other is the American Fisheries Society, not because I have had the honor of serving as your secretary, nor yet the still greater honor of today, but because my relations with the Society have brought me into contact with some of the salt of the earth, and have made for me some of the strongest and best and most enduring frienships of my life.

I joined this Society some 18 or 20 years ago, and have attended nearly every one of the meetings since that time. I have been present at a meeting when the total enrollment did not exceed 15. I have seen the Society on the rocks financially, and when the future looked none too bright, but thanks to the loyalty and persistency of the old guard, and the hearty cooperation of the United States Fish Commission, now known as the Bureau of Fisheries, and the boards of commissioners of the several states, and last but by no

means least, to having the best treasurer that this or any other Society ever had (applause), we are today, I believe on a surer basis and sounder foundation than we ever were before; and I believe we are going to continue to grow in numbers, strength and influence.

Gentlemen, if there were any doubt as to my appreciation of the high honor you have conferred, I have only to point to the long roll of able and distinguished men on the list of my predecessors. Referring to only a few who have passed to the great beyond and who have earned a nation-wide reputation by earnestly striving for what we today are striving for, we find in that list the names of Robert B. Roosevelt and Eugene G. Blackford, of New York, Henry L. Ford, of Pennsylvania, Marshall McDonald, of Virginia, and in my judgment, greatest of all, that magnificent man of brains and culture and heart, the noblest Roman of them all, General Bryant, of Wisconsin. (Great applause.)

In the presence of so many ex-presidents, I would ordinarily feel some delicacy in referring to any particular one, and would hesitate to do so, but there is one who, by his many years of unpaid and unselfish devotion to the cause of honest, progressive and scientific fish culture, has endeared himself to every member of this Society. We all know him and know his true worth, and his absence from this meeting is most keenly regretted. I refer to that grizzled old veteran and grand old man whom we all have learned to love, Hon. Henry T. Root, of Rhode Island. (Great applause.)

Just one more moment of your time. I want to urge every single member here to make a special effort to be present at the fortieth anniversary meeting and also to attend as many of the future meetings as possible. Make some personal sacrifice to do so, if necessary, and I want you to come prepared to offer some idea, thought, or suggestion that will be helpful to all of the members, and that will contribute to the common fund of fish-cultural knowledge. We must give and take in this Society; we must be

as willing to teach when we can as we are to learn when we can. We must be as willing to tell others what we know as we are anxious to learn what they know. In short, we must make this Society the great fish-cultural clearing-house for the interchange and taking up of old and new thoughts and ideas. In this way and in standing loyally first, last and all the time by whatever is for the best interests of this Society, may we hope or aim to be, or perhaps I should say continue to be, the one high-class, strongly-organized representative body in our field of endeavor in this country if not in the world. I thank you. (Great applause.)

I think the next thing on the program is to have the vice-president called on the carpet, and I will appoint Dr. Evermann as a committee of one to escort him to the front and put him on the firing line. (Laughter.)

Dr. Evermann: I am sure we will all be glad to have a word from our worthy vice-president.

Vice-President W. E. Meehan: Mr. President and gentlemen, you have done me an honor in electing me your vice-president. I am well aware that it is more of a courtesy position than one of active work. Nevertheless, I deeply appreciate it, and should occasion require my services they will be granted to the best of my ability. I suppose I will have to be simply in the position of the man in the western part of the state. He was not noted for his public spirit or usefulness, and he died with his boots on, as our ex-president aptly put it. Afterwards his friends, or the people, not knowing just what to put on the tombstone, and not wanting to tell any lies about him, carved this inscription:

> He done his damnedest,
> Angels could do no more.

(Laughter and applause).

President: I believe this Society would like to hear a word from our newly elected treasurer.

Treasurer C. W. Willard: I wish I could find words to express my feelings, but up to the present time, and I have

been treasurer of this Society since 1900, which means about 9 years, I have never before been asked to make a speech to you.

PRESIDENT: You have not been used right then.

MR. WILLARD: And I hope it may be the last. I can only say a very few words indeed. I accept this office fully realizing the responsibilities that may possibly be incurred by so doing, with the creation this year of new committees, and an assistant secretary who will have to be paid a salary, and a committee for the anniversary which will come off the next year, and also a salaried editor, which will probably take all the funds we can possibly raise. (Laughter.) However, as I have said several times previously, I will endeavor to raise sufficient funds. If they cannot be obtained from the members I will take them from my own pocket, and as I have always previously stated, if we find that the Society flourishes and there is a good sum coming into the treasury, I will take half of it and the Society can have the other half. (Great applause and laughter.)

INTERNATIONAL FISHERIES COMMISSION.

PRESIDENT: I understand Dr. Evermann has a word to say about the International Fisheries Commission.

DR. EVERMANN: I thought it might interest the Society to hear a word regarding the present status of the work of the International Fisheries Commission, about which something was said a year ago at the meeting in Washington.

The commission held several meetings after the completion of its field work last year, and made tentative drafts of regulations which it submitted from time to time to the various states that are interested, to the state fish commissioners for those states, and to the fishermen. After receiving the suggestions and recommendations from these various sources, the regulations were revised, and a revised copy was sent out for further criticism. I think as many as four different revisions were sent out from time to time.

As you all know, I think, Mr. S. T. Bastedo, the gentle-

man who was appointed originally as Canadian commissioner, resigned early in the fall, in order to accept a more lucrative position with the Canadian government, and Professor Edward E. Prince was selected to succeed him. The commission as thus constituted met in Washington, D. C., in June, held a number of conferences, and finally made its report to the respective governments on the 3rd of June last.

Following the recommendations of the State Department and of the Department of Marine and Fisheries of Canada, a number of matters which ordinarily would seem proper to have been included in the report were not included. Many matters in the report as it has been finally submitted, or many matters that might have been in it, have been omitted, and have been left to the respective states.

The report, as I say, was filed with the Secretary of State on the 3rd of June, and with the Canadian government on the same date. The report has not been promulgated by our government and will not be until Congress meets in December, when it will doubtless go to Congress in a message from the President, and go to the Canadian government at the same time. The recommendations in the report, I think, are known in a general way to the commissioners of the various states interested, and to the fishing interests along the line on both sides; but of course the report as a report will not be given out until it is made public by the President and by the proper authorities in Canada.

While the report may not contain everything which some of us think it should contain, it will doubtless serve as a beginning, as an entering wedge, which will work toward the solution of all of the difficult questions pertaining to the international waters.

It is interesting to call attention to the fact that there is growing up in Congress a very strong sentiment in favor of federal control of interstate waters. That feeling has been engendered and has been strengthened from two sources or because of two conditions—one the condition of the fisheries

in the streams in interstate waters, which cannot be controlled by any individual state, and the other the problem of pollution and public health. Take the Ohio River, for instance, or the Potomac or the Mississippi—no one state is able to control the fisheries or the waters of these rivers. So in order to secure proper control of the fisheries, federal control is suggested. A very potent factor is that pertaining to public health. George Shiras 3rd puts it very properly, it seems to me, when he says that if the matter reaches the supreme court it will uphold any decision on that line; that the federal government properly has jurisdiction over all interstate waters in so far as navigation, fisheries, and public health are concerned. Thus if it should ever come about you can see that the question of pollution of interstate streams becomes an easy one to handle, just as Pennsylvania is now handling the question, but it perhaps can not be controlled on the New Jersey side.

Mr. Meehan: We have passed some concurrent laws with New Jersey.

Dr. Evermann: Well, that is good. One result of the agitation for better control of interstate waters has been an effort on the part of the states concerned to get together and enact concurrent legislation. This has been particularly noticeable in the Columbia River region, where Oregon, Washington, and Idaho have been making a very heroic effort to enact concurrent legislation which will protect properly the fisheries of the Columbia River. Of course it makes no difference how the thing is brought about. The federal government will be just as well satisfied if Oregon and Washington can control the Columbia River properly as if they should fail to do so and leave it to the federal government eventually.

But the hopeful outlook is this, that through agitation of the question adequate control of interstate streams will be brought about in the not very distant future. Whether it will be exercised by the state or federal government is a matter of secondary consideration. (Great applause.)

Mr. Meehan: It is a source of satisfaction to me, at least, to hear that Congress is considering the question of taking charge of streams forming boundary lines between different states, even if it does not do it in the long run, because I believe it will bring about more concurrent laws. The very idea that Congress might do that brought about the concurrent laws between the states of New Jersey and Pennsylvania. The New Jersey legislature was not at all eager in the matter, until it was intimated by the commission appointed by the legislature of Pennsylvania that if they did not do something the United States possibly would step in; whereupon concurrent laws were passed and a section with reference to pollution, similar to that of interior waters, was adopted. Fishery regulations were also adopted. I cannot say that I think the fishery regulations are the very best, but they are now far better than before.

One of the great difficulties we have at present is with reference to Delaware and New Jersey, which have locked horns on the proposition of concurrent legislation. New Jersey wishes to have the same concurrent laws passed between it and Delaware that now exist between Pennsylvania and New Jersey. But little success has attended these efforts, and New Jersey has appealed to Pennsylvania. We are going to Delaware with a special commission, and we will put it strongly to them that it is the only thing to do to prevent going to the national government. A suggestion of this kind will probably prove quite efficacious, not only with reference to Delaware but other states similarly situated.

Dr. Evermann: It is quite interesting to know that a senator from Nebraska wrote to the Bureau of Fisheries that he was ready to introduce a bill providing for federal control of interstate waters, if the Bureau would sanction it and give him suggestions regarding the form of the bill. Of course the Bureau expressed its gratification, but stated that definite measures were not yet ready.

The international commissioners, Dr. Jordan and Prof.

Prince, are now visiting the fishing sections in the west, in the Puget Sound region. Since the middle of June they have been over lakes Erie, Huron and Superior getting suggestions and ideas from the fishermen and the fishery officials along the line. I expect to spend the next six weeks in Passamaquoddy Bay for the same purpose. I also hope to visit Lake Erie in the fall and meet Professor Prince to get the views of the people concerned. In these cases the fishermen and others are given an opportunity to see what the proposed regulations are, and at the same time their suggestions and criticisms are invited.

PRESIDENT: I would like to ask if the chairman of the resolutions committee or any other chairman has any further business to present?

MR. TITCOMB: The committee on resolutions wishes to offer the following:

WHEREAS, the State of Ohio, in conjunction with the States of Pennsylvania, Michigan, Illinois, and Wisconsin, has inaugurated in behalf of an historical and educational exposition at Put-in Bay Island in the year 1913, in commemoration of the one hundredth anniversary of the Battle of Lake Erie; and

WHEREAS, the said states have enacted legislation favorable to this enterprise and authorizing the appointment of commissioners to promote it; and

WHEREAS, it is proposed to hold a fisheries exhibit in connection with the proposed exposition under the auspices of the State of Ohio and the national government,

THEREFORE, BE IT RESOLVED, by the American Fisheries Society, that we cordially endorse the proposed exposition with reference to both its historical and scientific importance, but especially in regard to the opportunity it will present for the promotion of the fisheries interests of the Great Lakes; and we commend to the national authorities the suggestion of their co-operation in the project by means of an adequate fisheries exhibit under the direction of the United States Government.

The resolution was approved.

PRESIDENT: If there is no other business to come before the Society, the chair will entertain a motion to adjourn.

MR. CLARK: I would like to ask the assistant secretary to

be careful that all the various amendments to our constitution are included in the forthcoming printed report.

Dr. Bean: I would suggest further that the papers presented at these meetings be referred to the committee on publication. They are in the hands of the official stenographer, and some action should be taken with reference to the transfer of the papers to the committee on publication.

President: Should he not also transfer with the papers the transcript of his notes?

Mr. Clark: I move that the matter be referred to the incoming officers, or the president, vice-president and chairman of the executive committee. They can arrange with the stenographer.

President: The motion, as I understand it, is that the incoming officers are authorized to direct the stenographer to refer all of the papers and the transcript of his notes to the publication committee. Is that the motion?

Mr. Clark: Yes.

The motion, being seconded, was unanimously carried.

Mr. Meehan: I move that we adjourn *sine die*.

The motion prevailed.

President: The thirty-ninth meeting of the American Fisheries Society is adjourned *sine die*.

In Memoriam

WESTLEY S. HENRY

R. D. HUME

L. D. HUNTINGTON

WALTER L. POWELL

GEORGE F. PEABODY

REDFIELD PROCTOR

ALEXANDER STARBUCK

MEMORIAL

George Frederick Peabody.

It is with profound sorrow that a record is made of the death of George Frederick Peabody, Secretary of this Society. Prepared though the members were by the announcement at the Toledo meeting of his serious illness and the operation which was rendered necessary thereby, the weight of the calamity caused by the announcement of his passing away on Sunday, September 12, 1909, was in nowise lessened.

To the members of the American Fisheries Society he was more than a faithful, conscientious officer; more than a prominent citizen of Wisconsin; more than a state fish commissioner; he was a personal friend to every member; he had endeared himself to all by his uniform courtesy, sympathy and kindly disposition. When he attended the meeting of the Society in Washington in 1908, and when most of the members saw him for the last time, there was no outward indication that he was suffering from a fatal malady, and, indeed, he himself was seemingly unaware of anything of the kind until within a few weeks of his death.

The American Fisheries Society has lost one of its most faithful officers, one of its most active and enthusiastic members; the State of Wisconsin and the City of Appleton have lost one of their most prominent citizens.

Mr. Peabody's life is a shining example of American citizenship, of sterling American worth, and of American ideals of duty to mankind. He was a native of Connecticut, born in Milford, September 12, 1845. His death, therefore, occurred on the anniversary of his sixty-fourth birthday. He removed when a boy with his parents to Portage, Wisconsin, where he received his early education, and before attaining his majority, entered the employment of C. J. Pettibone, who conducted a dry goods, boot and shoe store at Fond du Lac.

He displayed such remarkable business aptitude that in 1872 he was sent to Appleton and made manager of Mr. Pettibone's dry goods store in that city. Under his management the business so expanded that it was transformed to an incorporated company with Mr. Peabody as its president.

He took a deep interest in educational affairs, and an active part in the advancement of the Lawrence (Wisconsin) University. He was a member of the board of trustees of that institution from 1896, and contributed generously to its different funds. He built and presented to it a handsome building as a conservatory of music, and was the founder of a prize to be competed for annually by students in Latin.

Mr. Peabody was an enthusiastic sportsman, devoted particularly to yachting, shooting and fishing, and was a prominent member in many clubs and organizations having these as prominent features. Governor George W. Peck appointed him a Commissioner of Fisheries in 1893 and he served six years. During his incumbency he aided materially in advancing Wisconsin among the foremost States engaged in fish culture. Becoming a member of the American Fisheries Society, he was elected its President in 1898. He was elected Secretary in 1901 and was re-elected annually thereafter. As Secretary he shared with the Treasurer, the President and the Chairman of the Executive Committee, the burden of the work of the Society between and during meetings. Indeed, his share was greater, for he took upon his hands the preparation and publication of the Transactions of the Society. His work is indelibly stamped on the history of the American Fisheries Society. He aided as few others in its prosperity and advancement. His death is an almost irreparable loss.

Wm. E. Meehan.

PART II

PAPERS AND DISCUSSIONS

A PLEA FOR THE SYSTEMATIC STUDY OF FISH DISEASES

By Tarleton H. Bean,
STATE FISH CULTURIST, ALBANY, NEW YORK.

It is not my intention in this paper to give a historical account of the origin and growth of fish culture, but rather to call attention to a present condition which appears to me to operate against the perfect and full development of this important arm of the public service.

We may briefly recall certain salient facts, such as the experiments of S. L. Jacobi, who, in 1741, took eggs from the common trout of Europe and fertilized them artificially. He hatched the eggs in wooden troughs with gravel on the bottom, imitating natural conditions as nearly as possible. In 1837 John Shaw was the first to artificially fertilize eggs of the Atlantic salmon in Great Britain; in 1854 Dr. Theodatus Garlick hatched brook trout eggs in Ohio; in 1856 Massachusetts appointed three commissioners, thereby inaugurating the beginning of public fish culture in the United States; in 1857 Carl Muller of New York and Henry Brown of New Haven impregnated whitefish eggs from Lake Ontario, and also tried to propagate the pike perch; in 1864 salmon eggs were sent from Europe to America, and they were hatched in New York City by James B. Johnson; in 1865 codfish eggs were first successfully hatched in Norway; in 1867 the shad hatching box, a floating box with wire bottom and furnished with wooden cleats, so placed as to tip the box at an angle to the current of the water, was invented and put into practical use. In 1868 New York State followed the example of the New England States by establishing a fish commission consisting of Horatio Seymour, Robert B. Roosevelt and Seth Green. These commissioners were appointed on April 22d. In 1870 the very well-known German association called

the Deutscher Fischerei Verein was organized, and in the same year there was formed the American Fish Culturists' Association, now known as the American Fisheries Society. This association was practically founded by Livingston Stone, ably seconded by Robert B. Roosevelt. In 1871 the federal Congress created the U. S. Fish Commission, which is still very actively engaged in fish culture and allied operations, its present name being the U. S. Bureau of Fisheries. The formation of this great establishment was urged by a committee of the American Fish Culturists' Association, as well as by the Fish Commissioners of New York State, and especially by Robert B. Roosevelt.

It may be permissible here to note the fact that fish culture by the States at first related almost exclusively to the culture of brook trout and Atlantic salmon. The Fish Commissioners of New York were the first to inaugurate a wider range of activities, including exchanges of eggs with foreign countries. Most of the states, in fact, nearly all the states, have had fish commissions in operation for a long period of years, and the aggregate of work accomplished by the states is enormously large. The states have also devoted a great deal of time and care to the study of problems in fish culture, with especial reference to improvements in the taking and handling of eggs and the rearing and distribution of young fish of various ages. The federal government plants fish and eggs by the billion. Some of the states will undoubtedly soon reach the billion mark in their total of fish distribution. Wonderful improvements have been made in the apparatus of fish culture, in the construction of ponds and hatcheries, cars, and in the general management of fish cultural work. There is no doubt that in most respects the federal government outranks all other governments in the care and precision attending its labors.

At the same time, every practical fish culturist now present will, I am sure, agree with me that we still lack some things of the utmost importance. For example, we know only too little about the causes and the treatment of the diseases of

fish. Unintentional as well as willful violations of the fish laws of the states might be greatly lessened by means of clearer definitions of the names and terms employed in those laws. A small illustrated pamphlet or book containing descriptions of a popular character and figures of the important food and game fishes would prove extremely valuable in educating the people and explaining the law. Thorough investigation of the animal and plant life of the waters of nearly all the states is greatly needed as a basis for practical work. We have devoted too little time, and consequently have too scant information about the results of fish distribution. We have not gone very fully into a systematic investigation of the habits and the growth even of our common fish; and especially are we helpless in relation to the diseases of varied origin which often sweep away in a few months the entire result of years of patient labor.

In order to illustrate more effectively the condition of affairs to which I refer, I have collated from the catalogues of publications issued by the U. S. Fish Commission and Bureau of Fisheries a list of titles of papers relating particularly to fish diseases. I have added to this list some references to papers which have appeared in publications by states and by private individuals; but I regret to say that the entire showing is pitifully incomplete and meagre. It is true that my time has prevented me from going fully into the bibliography of papers discussing the diseases of fish, but I have gone far enough, I think, to demonstrate the point taken, which is, that we are devoting too little attention to the subjects upon which the very life of our work depends. It is certainly desirable that we consider this matter seriously and endeavor to correct the condition of affairs as speedily and as completely as possible.

An examination of the bibliography of publications which forms a part of this contribution will prove that very little attention has been given by either the federal or the state governments to the study of fish diseases, and the investigation of the habits and growth of fish. You will not find in any

publication known to me in the English language any general account of the epidemics caused by parasites of various kinds or by diseases due to injurious bacteria, which are so abundant in the fresh waters. Whenever a practical fish culturist desires to inform himself on a subject of such grave importance, he must either consult the *Handbuch* of Dr. Bruno Hofer, published in Germany in 1904, or search through the thousands of publications issued in the last half century by federal and state governments, and in the transactions of learned societies. This involves a tax upon the time and intelligence of the fish culturist which he should not be expected to endure.

In the list of papers I have in some cases made an abstract of the author's recommendations. I have done this for the benefit of those fish culturists who have not time to read a mass of literature. I am sorry to have to confess that wherever one may turn for information, he will as a rule soon discover that while the disease may be described in a way, in most cases the cause of the disease and its treatment are either incompletely mentioned, or not mentioned at all.

I am well aware that the number of investigators in this important field is very small, and that nearly all of the men who are qualified to conduct these studies are engaged in other duties which may appear to be more important, and, at the same time, more remunerative to the investigator. This is a matter which should not be lightly considered or wrongly considered. The laborer is worthy of his hire, and if he cannot secure the returns so essential for his welfare in one direction, he is in duty bound to seek another field giving promise of suitable reward. Our scientific men associated with the study of the culture of the animal and plant life of the waters are very busy with their investigations in fields near and remote, and their work is winning well-merited applause at home and abroad. They are laboring under one of the greatest difficulties which attends scientific work, namely, scant appropriations. It seems to me perfectly proper to state that the allotment for scientific inquiry in general is in-

significant, compared with the economic value of the researches coming within the scope of this division. I would respectfully suggest that the amount of money made available annually for such investigations be greatly increased, and that the program of the work be made to include more extended studies of the same character as those engaged in by such bacteriologists and pathologists as are mentioned in the bibliography hereto attached. Any fish culturist present can readily suggest subjects of study, and all fish culturists will be grateful for the information which is sure to result from these activities.

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Refers to white spots on eggs, apparently vegetable parasites; white spots in the sac, an uncontrollable disease. Salt and mud were tried as remedies, but without permanent benefit. Fungus (*Saprolegnia*) attacks eggs and fish. Salt bath for the fry was beneficial. Artificial shade might also be helpful.

Tarleton H. Bean.—Fish Diseases. Twelfth Ann. Rep. N. Y. F. F. & G. Com., pp. 129-130 and pp. 131-142, 1907.

Describes an undetermined bacterial disease which destroys the eyes of trout perch, yellow perch, black bass and other fish of immature age. Translations are given from the German of Dr. Hofer on the ulcer disease of the brown trout, the spot disease of the brook trout, the red plague of the carp-like fishes, the scale disease of the whitefishes such as ide, rudd and carp, and the red plague of the eel. The above also issued as a separate in which the notes appear on pp. 52-53 and 54-65. See also the Thirteenth Ann. Rep. of the same commission pp. 112 and 124-125, or the author's separate, pp. 39 and 51-52, 1908.

Gary N. Calkins.—Report upon the recent epidemic among brook trout (*Salvelinus fontinalis*) on Long Island. Fourth Ann. Rep. N. Y. F. F. & G. Comm. for 1898, pp. 175-190, pl. i-viii, figs. 1-7.

A very clear and valuable account of this parasitic disease, due to *Lymphosporidium truttæ*, a sporozoan classed among the most destructive of the fish parasites, causing extremely fatal epidemics among brook trout of all ages. The fish may not be the original host of the parasite. Similar organisms are found in the body cavities of various crustacea (*Daphnia*, *Gammarus*, *Cypris* several species). The trout may swallow the form containing this protozoan. Recommends the destruction of all diseased fish by burial or burning, draining the ponds and exposing them to the sun for a few months, scrubbing the runways and removing all growths; avoid interbreeding with the diseased fish, keep the water perfectly clean and cold, sustain the vitality of the fish, watching for and removing fungoid growths, avoid constant interbreeding by frequently introducing new blood, inspect the food carefully and do not allow it to stand exposed to flies and other insects but have it fresh.

Frank N. Clark.—Lake trout diseases. Manual of Fish Culture, U. S. F. C., 1900, p. 105.

The diseases are the same as in all other trout. The causes are impure water, poor food, and injuries received. Salt and swamp earth are used in treatment.

G. P. Clinton.—Observations and experiments on saprolegnia infesting fish. Bull. U. S. F. C., xiii, 1893, pp. 163-172, 1894.

M. G. Craft.—Brown trout disease. Eleventh Ann. Rep. F. F. & G. Comm. N. Y., 1906, pp. 115-116.

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F. P. Gorham.—The gas-bubble disease of fish and its cause. Bull. U. S. F. C., xix, 1899, pp. 33-37, pl. 12, 1900.

Loren W. Green.—On a disease affecting the rainbow trout at McCloud River Station. Bull. U. S. F. C., v, 1885, p. 742, 1885.

R. R. Gurley.—On the classification of the Myxosporidia, a group of protozoan parasites infesting fishes. Bull. U. S. F. C., xi, 1891, pp. 407-420, 1893.

R. R. Gurley.—The Myxosporidia or psorosperms of fishes, and the epidemics produced by them. Rep. U. S. F. C., xviii, 1892, pp. 65-304, pl. 1-47, 1894.

Bruno Hofer.—Handbuch der Fischkrankheiten. With 18 color plates and 222 text figures, pp. xv, 369. Munich, 1904.

This valuable synopsis contains numerous descriptions of diseases affecting fishes of the United States some of which have been introduced into Europe, and also European fishes which have been acclimated in our country. The book contains chapters on furunculosis or ulcer disease, the red plague of the carp-like fishes, the red plague of the eel, the salmon pest, the yellow plague of the redeye, or so-called pearl roach of New York City lakes, the spot disease of the brook trout, tuberculosis in fishes, smallpox in the carp, together with interesting accounts of the diseases of the skin, the gills, the intestines, the liver, swim-bladder, and the various viscera and organs of the body, the parasites and bacterial affections of many species well known to us as fish culturists. The most striking difficulty encountered in the use of this work arises from the slight knowledge available concerning the origin and treatment of the diseases referred to.

C. Kerbert.—Chromatophagus parasiticus: A contribution to the natural history of parasites. Rep. U. S. F. C., xii, 1884, pp. 1127-1130, pl. i, 1886.

Herbert M. Knowles.—Dead fish on the coast of Rhode Island. Bull. U. S. F. C., vi, 1886, pp. 194-195, 1886.

Edwin Linton.—On certain wart-like excrescences occurring on the short minnow (*Cyprinodon variegatus*) due to psorosperms. Bull. U. S. F. C., ix, 1889, pp. 99-102, pl. xxxv, 1891.

Edwin Linton.—A contribution to the life-history of *Dibothrium cordiceps*, Leidy, a parasite infesting the trout of Yellowstone Lake. Bull. U. S. F. C., ix, 1889, pp. 337-358, pl. cxvii-cxix, 1891.

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M. C. Marsh.—A more complete description of Bacterium truttæ. Bull. U. S. F. C., xxii, 1902, pp. 411-416, pl. i and ii, 1903.

M. C. Marsh.—The Cold Spring Harbor epidemic among trout. Tenth Ann. Rep. F. F. & G. Comm. N. Y., 1905, pp. 125-139, with one plate.

Ascribes the disease to *Lymphosporidium truttæ* of Calkins. In treatment avoid overcrowding, transfer to much larger quarters with rapid flow of water, and disinfect the ponds with chloride of lime or copper sulphate.

M. C. Marsh.—Brown trout disease at Pleasant Valley Hatchery. Eleventh Ann. Rep. F. F. & G. Comm. N. Y., 1906, pp. 117-118.

Describes this as a bacterial disease caused by *Bacterium truttæ*. The disease is known from Northville and Paris, Mich., and Bayfield, Wis. Recommends transfer to more roomy quarters and heavy water flow. Treatment by copper sulphate is recommended. A very low temperature will prevent *Bacterium truttæ* from growing, say creek water at 43 degrees Fahr. or less.

M. C. Marsh and F. P. Gorham.—The gas disease in fishes. Rep. U. S. B. F., 1904, pp. 343-376, pl. i-iii, 1905.

W. S. Marshall and N. C. Gilbert.—Notes on the food and parasites of some fresh-water fishes from the lakes at Madison, Wis. Rep U. S. B. F., 1904, pp. 513-522, 1905.

Fred Mather.—Modern fish culture in fresh and salt water. Forest & Stream Pub. Co., 1900, pp. 255-257.

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Fred Mather.—A trout epidemic, etc., Modern Fish Culture, pp. 260-267, 1900.

Hugo Mulertt.—The goldfish and its culture, third edition, Brooklyn, New York, 1902, pp. 129-136.

The diseases named are: asphyxia, treated with salt; tuberculosis, without effective remedy; slime or itch, remedy, table salt with tadpoles and snails to consume surplus food; dropsy, for which there is no good treatment; erysipelas, caused by improper feeding, treated by placing the tanks in sunlight and withholding food for a month.

Charles N. Page.—Fish diseases. Aquaria, Des Moines, Iowa, 1898, pp. 34-37.

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John A. Ryder.—On a skin parasite of the cunner (*Ctenolabrus adspersus*). Bull. U. S. F. C., iv, 1884, pp. 37-42, 1884.

Mark Samuel.—Goldfish maladies. The Amateur Aquarist, The Baker & Taylor Co., New York, 1894, pp. 42-46.

The maladies named are fungus, treated with salt; consumption, arrested by removal to larger quarters with healthy, growing plants, feeding regularly daily with small earth-worms or beef and fish food alternately; have active tadpoles and snails in the tank; twitters or itch, caused by a parasite allied to *Saprolegnia*, remedied by removing all refuse and adding a few snails and tadpoles until the disease disappears; bladder complaint, aided by removal to a hospital aquarium and reducing the water until it barely covers the top of the dorsal fin; feed the fish as usual, keep the water pure, place the aquarium in a cool room; dropsy, helped by using five to ten drops of digitalis in a gallon of water; partial suffocation, cured by placing in large vessels in little water and adding salt to the water.

George F. Scriba.—Eye disease of yellow perch. Eleventh Ann. Rep. F. F. & G. Comm. N. Y., 1906, p. 113.

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Eugene Smith.—Diseases of fishes. The Home Aquarium, E. P. Dutton & Co., New York, 1902, pp. 182-183.

Mentions parasites among crustacea, worms, protozoa and fungus, recommending that the last be treated with salt and potash permanganate.

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DISCUSSION.

Mr. Seymour Bower (in chair): I hope you will all have some comment to make on this interesting paper. The doctor is, perhaps, too modest to start the discussion. We want to hear something from every one present, and also to draw out a great deal more from the doctor. I

feel sure he has much in reserve, and the way to bring it out is to have a free discussion.

PRESIDENT: There is one thing that I would like to add a little later, illustrating the wide spread of diseases which we have constantly to face. In the course of the discussion I would like to read a letter relating to a throat tumor affecting brook trout in California, but I do not think I should give the name of my correspondent.

MR. CHARLES W. BURNHAM: Do you know of any instances where these diseases are communicated to the human race?

PRESIDENT: I have seen newspaper statements to the effect that certain French and German scientists believe and have perhaps so stated, that in Argentina cancer has been transmitted from fish to the human being. I do not know whether these scientists are correctly quoted. Certainly I have seen no statements in scientific papers that cancer in the human being is derived in any way from eating or handling diseased fish. I do not think that any scientist, at least in the United States, is ready to say that thyroid carcinoma in brook trout, and which, by the way, attacks the brown and rainbow also, is communicable to man. I recently talked with one of the foremost students of cancer in the United States, and I know that he will not make such a statement. He is simply trying to study the disease in the fish to discover, if he can, how it is communicated from fish to fish, as it is, of course, very contagious, and what it is in the water (because it is always communicated in water) that introduces the disease into the fish. He begins to think that some of the crustaceans may be at the bottom of the whole trouble, but he has not so expressed himself as yet.

MR. FRANK N. CLARK: This paper is very interesting. Referring to Mr. Burnham's question whether any disease may be transmitted to the human race from fish, I want to say that I saw Mr. M. C. Marsh inoculate himself with the *Bacterium truttae,* which was killing thousands of trout at Northville. He did not hesitate to take the chances, and it did not harm him in any way.

Now, the diseases of fish differ at various places, especially with trout. At Northville, for instance, we can raise brook trout up to fingerlings *2* or *2½*, and occasionally to 4 or 5, without any difficulty whatever. By actual count and weight we raised this year 125,000 number *2* fingerling brook trout from 150,000 fry.

On the first of July I had orders from Washington to put 10,000 of these fish in a pond. They were just as nice No. *2* trout as you ever saw. Today, if you will count the live fish there, I guarantee that you will not find 2,000, 80 per cent having died since the first of July.

Now, we want to know what causes it. Why is it that at Northville we can raise trout up to two inches with such excellent results, while Mr. Bassett, at Paw Paw, Michigan, who is raising trout commercially, has great difficulty in growing them to that age or size? When once he gets them past the No. *2* stage he markets 18,000 out of 20,000 at two years old. He told me the other day that he had no difficulty whatever after getting them past the No. *2* stage. At Northville it is just the reverse; we grow them to the No. *2* or *3* stage, and they are then

apparently as healthy as any fish you ever saw. However, when we try to keep them after that time they die off rapidly, probably from the same disease—the *Bacterium truttae*—that Mr. Marsh first discovered at Northville some 8 or 10 years ago. We have had it there ever since, though we thought at one time we were rid of it. The disease has affected fish kept in a large wild or natural pond as well as those in cement ponds. Mr. Marsh made a careful study of the subject at the time, but has since been working on other matters. This is work for the scientist, as the fish culturist already has too many duties, and besides usually lacks special training for such work.

Mr. W. E. Meehan: What is the general appearance of the disease, and how do the fish act?

Mr. Clark: The trout appear to be all right, when, without any warning or apparent cause, they commence working down to the lower end of the pond, where they may go against the screen or may not. But they dart about in apparent distress and finally die and sink to the bottom. Sometimes but not always a blotch will be seen on them.

I think Mr. Marsh states in his paper that he found in the soil at Northville something on the order of the lockjaw germ, the tetanus bacillus. Of course, the lockjaw germ is in the ground all the time; at least, so I understand. Mr. Marsh thinks that the *Bacterium truttæ* is similarly in the soil at Northville and through it and the action of the water attacks the fish. There seems to be no difference whether the fish are in the head pond where spring water first enters, or farther down in a series of ponds. At Northville the disease has never attacked anything but the brook trout.

Mr. W. E. Meehan: The remarks of Mr. Clark are very interesting. We had trouble in one of our hatcheries at Bellefonte for three successive years, and it was very similar to what Mr. Clark describes. We had about ten or a dozen ponds located just outside of the hatching house. They were built of concrete—sides and bottoms—so located that only about a foot of water could be carried. In some of the ponds the young fish up to No. 2 fingerlings did first rate, but in others soon after reaching that size they began to die off very rapidly, the action being just about as Mr. Clark describes. They would move around sometimes sluggishly, again a little more rapidly, then toward the outlet of the pond, and sometimes towards the surface, then they would turn over and die. On one occasion we lost 90,000 in a little while. We tried a number of remedies. We covered the bottom of the ponds with gravel, some of them to a depth of six inches. We kept them thoroughly cleaned, scrubbed the sides, salted them and tried every method we could. In some instances the fish would do well in certain ponds, but nothing could be done to save the fish in two of the ponds. When we gave up using these ponds and transferred the fish to ponds having concreted sides, gravel bottom and two and a half feet of water, we had no more trouble. For two years we have had a low death rate among the fingerlings in these deeper ponds. We have occasionally tested the other ponds, but the same trouble has always developed. A curious feature

is that our yearlings do well in any of the ponds, thus adding to the difficulty of solving the problem. The disease occurs only during the summer months, and while the fish range in size from No. 2 to No. 4 fingerlings.

Going to another point in fish disease: At one of the commercial hatcheries in Pennsylvania and also in the ponds of an organization in the State which has a private preserve, there appeared a boil-like disease in the throat, similar to a tumor; and probably one fish out of every 7 or 8 had this disease. I visited the commercial hatchery and found the ponds inexpressibly filthy; some of them had not been cleaned for 10 or 12 years; and in these there was two feet of mud and dirt and filth of all kinds. I recommended the cleaning of the ponds and the construction of new sides. Word was received the other day that the disease had entirely disappeared from the place, giving the idea that this particular disease is caused largely by a filthy condition of the ponds.

Mr. John W. Titcomb: I think possibly this subject of fish diseases is one that we could discuss the entire time that is allotted for these meetings. It seems to me the chief trouble is not in discovering what the disease is, but in finding a remedy; and until we know more about it every fish culturist must keep his place as clean as possible, and thus avoid many diseases which otherwise may creep in.

The disease at Northville, which has been ably written up by Mr. Marsh, is one for which there appears to be no remedy. It may be possible to have an arrangement whereby something can be put into the water, a minute portion of copper sulphate, for instance, to counteract the effect of the bacteria, but it is rather questionable whether this would pay.

The Bureau has given up the idea of propagating brook trout at Northville, or rather of rearing them and carrying a brood stock, although we raise the fish up to a proper size for distribution as fingerlings. We have, however, been experimenting there on the subject of breeding with a view to ascertaining whether it is possible to secure a race of fish which are immune. By attempting to rear 10,000 of these trout to adults, we hope to ascertain whether out of the 10,000 there may be 500 or 1,000 which survive the disease—we would expect them all to have it—and then from these survivors breed a race possibly immune. This is merely an experiment, and though perhaps not of practical value, it may produce some results. The so-called throat disease is being very thoroughly investigated by the Bureau at this time by a specialist well informed on the subject. It is not generally thought by physicians that the disease is transmitted to the human being, at least if the fish is cooked.

An important point to be ascertained is where the fish first get the disease; whether it comes from the feeding of hog's plucks or the plucks of other animals. Possibly it comes from this source. It must be transmitted through the water from one point to another, which emphasizes the desirability of having each pond independently supplied when possible to do so. These problems are being taken up by the

Bureau. We could employ many more men on all these subjects, not only of fish diseases but others which are co-ordinate.

At this time the Bureau is having made analyses of the water supplies of all of its hatcheries. Today no one can tell by an analysis of the water whether it is suitable for supplying a fish-cultural station. We are not even sure that we shall be able to establish a basis of analysis whereby it may be definitely known that the waters will be suitable for fish culture. We know that many hatcheries have been started where the water supply at the time was inhabited by fish. The natural inference, therefore, was that the water would be suitable for fish-cultural purposes. But it often appears that such is not the case when the fish are crowded together under artificial conditions. So far as known, none of these diseases which the fish culturist encounters is the cause of much, if any, mortality among the fish in their natural habitat.

At one station where for twenty years before a hatchery was established the water supply was used for the maintenance of a series of trout ponds for the pleasure of a few sportsmen, the same water supply today will hatch one or two millions of trout, but at the time of sac absorption practically 80 per cent. of them die. Restock that hatchery from another station with sac absorbed fry and it is possible to rear any reasonable number of them to fingerlings.

At another station the water contains a superabundance of air, and this superaeration seems to be as dangerous as the lack of it. The old-time fish-cultural writers who always required that you must locate a hatchery away from the source of a spring and give the water a chance to get into a normal condition, possibly did not realize that they were taking precautions against superaeration as well as deaeration, the one being as important as the other.

The Bureau is making many observations along other lines. The question of fish diseases must be investigated thoroughly, and after we discover what the disease is there is the great difficulty of combating it. In some instances the best way is to give up attempting to propagate fish where the water supply seems to develop a disease like that produced by the *Bacterium truttæ,* for instance.

This emphasizes the necessity of so locating hatcheries that they may be first operated as field stations. If you want to locate a trout hatchery and you see trout in a stream, don't take it for granted that everything is all right. Set up one or two troughs in a tent or shanty at an expense of $100 or $200; put one man at work hatching the eggs; raise the fry to fingerlings, carry them on through for a year—if any doubt arises make it two years—and crowd them as much as you would at any fish-cultural station. In this way mistakes will be avoided and much money saved for the purchase of sites and the construction of buildings and ponds where the conditions are known to be right. (Applause.)

President: Any further remarks on this subject?

I dislike to take so much time of the Society, but really I think I ought to explain my attitude on this question of the investigation of fish diseases. I do not find fault with anybody; I am not here to con

demn, but to praise. I think the work that has been done by the states and by the Federal Government has been the greatest work ever done, but what I am sure all of us would like to see is continuous, uninterrupted, close study of this subject which is so vital to the results of public fish culture. Why don't the specialists, the pathologists and bacteriologists go on with their studies? Why are they switched off to some work other than that for which they are prepared? The only reason I can see is that the federal government and the state governments will not pay a living wage.

This very throat tumor that you all know about is in California now; perhaps it came from there; we do not know anything about that; it may have come along with the rainbow trout; it may travel with the eggs; it may be that the eggs we are buying from commercial hatcheries are taken from fish which have had this disease, and their progeny will continue to be subject to it, that is to say, they will be prone to it, and more likely than not will suffer from the attacks of these injurious bacteria which may be present in all the waters. We know nothing about it, and I for one wish that the men who are able to investigate and to recommend would go on investigating and recommending until we stop this dreadful loss to the states and the federal government.

Here is a letter from California that I received only recently, about brook trout obtained from the Sisson hatchery, one of the state hatcheries of California. Here the tumor disease has developed, though perhaps not recognized in California before. Would not this seem to indicate that we are sending it out with the eggs, perhaps spreading it broadcast? We cannot afford to rest on our oars, and say, "Oh, that is not our affair." It is my affair, it is your affair. The American Fisheries Society and all fish culturists, in fact, are in duty bound, it seems to me, to ask for information though we may not always get it, but if we keep on asking and investigating we will succeed, just like the story dear old Professor Mason used to tell about the little bird that in time of storm lit on a great ship. There was no land near by, and it took refuge on a mast of the ship, and eventually found its way to the deck, where it was cared for until land was sighted; then it was liberated; and so its poor little life was saved. The moral is (this story is supposed to have been written by a boy of ten) "If you don't get what you want at first, just keep on trying, and you will get it by and by." I think if we keep on urging the matter and show the necessity which we all recognize, we will find an improvement before many years.

Mr. Charles W. Burnham: There are two possible causes for these diseases that I have not heard mentioned. One is the condition of the food. It may be too old or in some other way unfit and thus bring on disease. Another is the quantity of food. Overfeeding may induce disease. Some attention should be given to these points.

THE FISHERY CENSUS OF 1908

By Charles H. Stevenson,
DETROIT, MICHIGAN.

The value of statistical information in regard to the commercial fisheries has long been recognized. As early as the census of 1840, the products of the fisheries formed a subject of inquiry; and they received more or less attention in the censuses of 1850, 1860, 1870, 1880, and 1890.

As the industries of the country developed, the census work became so extensive and complicated that, owing to the temporary character of the organization, it was found impracticable to give necessary attention to the many subjects and to get out the reports in time to have great practical value. Consequently in arranging for the census of 1900, Congress limited the subjects canvassed, the results to be published within a reasonable time. Among the subjects thus omitted was the fisheries.

In the meantime, to supply the well-recognized need for information, the United States Fish Commission had organized a small statistical force, which made a fishery census of a portion of the country each year, covering the entire country in about five or six years. The work of that office affords the most satisfactory figures for the fisheries of the country from its organization in 1888 up to 1905.

The establishment of the permanent Census Bureau at Washington in 1902 resulted in a somewhat radical departure in government statistical work. Placing the Bureau upon a stable basis, equipped for practically continuous work and organized upon a scale sufficiently broad to permit the effective handling of any statistical inquiry, seems to indicate that purely statistical work of every description will be more and more concentrated in this office, which will thus become,

like similar bureaus abroad, the general statistical clearing house of the government.

Recent legislation limits the decennial work of the census to three general topics, namely, population, agriculture, and manufactures, leaving for the intermediate period—for the seven intercensal years—many special subjects of inquiry, prominent among which is a decennial census of the fisheries, which was specially authorized by act of Congress of June 7, 1906.

In view of the fact that in the employ of the Bureau of Fisheries were a number of men well informed in this special field, a plan of co-operation between the two bureaus was authorized and arranged for this decennial census. A further object of this co-operation was to avoid a duplicate canvass in a portion of the country and to insure uniformity in the statistical work of the two bureaus.

This co-operative work affords an excellent illustration of the relationship which doubtless will ultimately be established between the Census and the various technical bureaus of the government, and is another evidence of the advantages which spring from the establishment of the permanent Census Office.

Mention should be made of the very creditable statistical work being done by several of the States through the fish commission boards and other organizations. Michigan, Maine, Massachusetts, Rhode Island, Connecticut, Maryland, Oregon and several other States collect more or less statistical data. It is hoped to extend the co-operative work of the census of the fisheries to these organizations.

In scope this census applies to the commercial fisheries only, that is, all fishing operations conducted for profit—for the sale of the catch; but it does not include the operations of individuals catching fish for their own consumption or for sport. It covers, in addition to all species of fish proper, such products as whales, seals, turtles, shell fish, and sponges, and likewise the pearl fisheries.

In accordance with the general plan the census of the fisheries was inaugurated in February of the present year. About 40 expert employees, skilled in statistical inquiries, including 4 from the Bureau of Fisheries, were assigned to different parts of the country wherever commercial fisheries are presented, on the interior rivers and lakes as well as on the Atlantic and the Pacific coasts, the Gulf of Mexico and the Great Lakes, covering not less than 30,000 miles of shore line. These agents were provided with appropriate schedules to be filled out and signed as far as practicable by each person conducting independent fishing operations. At present the field work is nearly at an end, representing an average of about 4 months work for each of the men employed, or on a basis of 160 months for one man, and the number of schedules received approximates 25,000.

When I suggested to our esteemed secretary the subject of this paper, I entertained the hope that the work would be sufficiently advanced at this time to permit a general exposition of the results. But unfortunately for the purpose of these remarks, the returns for only a few States are now available. These, however, afford some very interesting comparisons.

Probably none of these is more striking than the very great increase in the carp fishery. Ten years ago the total catch of this species throughout the United States approximated six million pounds. According to the present census, the yield in a single State was more than three times this quantity, amounting to 21,342,300 pounds, for which the fishermen received $562,410. In this State, Illinois, the yield of carp in 1894 was reported at 860,330 pounds; in 1899 it was 9,869,499; whereas in 1908 it was more than 24 times as great as in 1894.

The increase in carp elsewhere has been almost as striking. In those States bordering the Missouri River the yield in 1894 was 343,969 pounds; 1899 it was 1,492,625; while in 1908 it increased to 5,351,100 pounds, or nearly 16 times as great as 14 years before. In the Ohio Valley the increase

since 1894 has been about 1,500 per cent. In Minnesota and Wisconsin the increase has been from 6,863 pounds in 1894 to 228,690 in 1899, and to 3,379,400 in 1908, or 49,000 per cent more than in the year first named.

The increase in abundance of carp has not unfavorably affected the yield of the more valuable species, as appears from the returns of the present census. For instance, the yield of black bass in Illinois shows an increase from 96,829 pounds in 1894, to 126,180 in 1889, and to 502,300 pounds in 1908, or more than five times as much as in 1894. In those States bordering the Missouri River, the yield of this species shows an increase from 195,867 pounds in 1894 to 413,100 in 1908. In Tennessee and Kentucky blass bass have increased from 98,195 pounds in 1894 to 184,200 pounds in the census year.

A similar condition exists in the yield of crappie. Illinois shows an increase in this species from 168,280 pounds in 1894 to 356,320 in 1899 and to 1,260,560 pounds in 1908. In the States bordering the lower Mississippi there appears an increase from 298,500 pounds in 1894 to 486,000 pounds in 1899 and to 684,000 pounds in 1908. In those States bordering the Missouri River the yield of crappie has increased from 180,200 pounds in 1894 to 471,000 in 1908.

A similar comparison might be made for bream or sunfish, which shows a corresponding increase; the combined yield in Missouri, Tennessee, Arkansas, and Iowa amounting to 155,000 pounds in 1894, 325,000 in 1899, and 954,000 in 1908, or six times as much as in the year first named.

Probably more interesting to the fish culturist of the Great Lakes is the very large increase in the yield of whitefish, especially in Lake Erie, where the results of the hatching operations are especially striking. The catch of the fleet of vessels at Erie, Pennsylvania, for instance, shows an increase from 53,276 pounds in 1903 to 451,200 pounds in 1908, or nearly nine times as much. The increase of whitefish in Ohio and Michigan has been large, but probably not so great correspondingly as in Pennsylvania.

DISCUSSION.

Mr. Frank N. Clark: It is very interesting indeed to note these increases. If I remember correctly, we have members of this Society—I think my friend Mr. Fullerton is one of them—who tells us that fish are not increasing.

Mr. S. F. Fullerton: I still claim it for Lake Superior, Lake Michigan and Lake Huron.

Mr. Clark: I am anxious to compare the report for the whole of Lake Erie and Detroit River for the present year with that of previous years, 1894 to 1899 and other years. We have kept a little run of this matter from year to year through the satistical agent of the Michigan Fish Commission. I have some figures that were compiled by him and given to me yesterday. On the American side of the Detroit River, in 1906, there were caught 68,000 pounds of whitefish; 69,000 pounds in 1907, and last year the catch was only 25,000 pounds. Unquestionably the cause of the decrease was due to the extensive dredging operations by the Government near the mouth of the river before and during the fishing season.

The figures for the first district of Michigan above Detroit show an increase, but for the Detroit River alone a decrease; while in Lake Erie and in Lake Michigan there has been a very marked increase. Without doubt the decrease is caused by the blasting referred to, coffer dam construction and other features of the Detroit River channel improvement work. This kept the fish back last year, and it may continue to do so for four or five years. But certainly it is going to be interesting to take Lake Erie and the Detroit River together, and see what the increase is. Then we will know whether we were right in stating that on account of the large number of fish planted the fishing in Lake Erie has increased much more than in the other lakes.

Mr. Fullerton: No one would be more pleased than I to see an increase in the Great Lakes fishing; and I am glad to hear this of Lake Erie and some of the other lakes. But as to conditions on Lake Superior I refer you to the paper I read before this Society three years ago. In 1879 I went to live on the shore of Lake Superior, at Duluth, and know the conditions then existing there in regard to whitefish and trout. Today you have to go 100 miles from Duluth before you can get any trout or whitefish. I was in hopes that some of these statistics would apply to Lake Superior.

Mr. Charles H. Stevenson: Unfortunately the figures for Lake Superior, because of the lateness of the season, could not be obtained.

Mr. Fullerton: There is no question but that the fish are disappearing there. I know from personal observation.

One of the noteworthy things shown by Mr. Stevenson's report is the increase of bass and crappie where the carp have increased in the Mississippi River. We gathered some statistics ourselves and found that from the Iowa line to the St. Croix River $750,000 worth of fish, over 80 per cent. carp, were marketed in a single year. In the same territory the bass and crappie have increased along with the carp, which is very gratifying. I have been an enemy of the carp, but am changing

my mind, for I believe that the carp supply food for the bass and crappie.

Mr. W. E. Meehan: The increase of fish in Lake Erie has not been confined entirely to whitefish. There have been increases in other species, the lake herring for instance. The increase of lake herring has been so great in Lake Erie that at times last summer and fall the dealers could not handle all that were caught. There also has been a marked increase in the blue pike catch of Lake Erie, especially in Pennsylvania waters. According to the fishermen on the Canadian shore opposite Pennsylvania and up to the New York line the same conditions prevail there, viz.: an increased catch of herring, pike and whitefish. There have likewise been marked increases in the catches of game and food fish throughout the state, such as bass, trout and the like. There has been a great increase in the catch of carp in Pennsylvania. I have always been a pronounced enemy of the carp, believing it to be a common, worthless fish, but along with some others must revise my opinion so far as its value for food purposes is concerned. It today ranks, from unofficial figures, about fourth or fifth in value in the state of Pennsylvania. I shall be able to speak more definitely another year as to catches of the various fishes, because a new state law requires that returns be made to the Department of Fisheries of all species of fish taken in the waters of the state.

Mr. Clark: Regarding fishing in Lake Superior, Mr. Harry Marks, who is in immediate charge of the state hatchery at Sault Ste. Marie, informs me that as the result of our hatching whitefish there for a number of years the principal fishermen at Whitefish Point on Lake Superior say that they are taking more whitefish this season than for many years. They report taking more whitefish this year out of seven pound-nets than they did a few years ago from seventy pound-nets; and these fish were all what are called "jumboes" (four-pound fish and upwards). They were nearly all Lake Erie whitefish, too. It is very easy to distinguish the whitefish of Lake Erie from those native to Lake Superior. This condition seems to indicate that whitefish are showing a marked increase at the east end of Lake Superior, whatever the situation may be at the west end.

Mr. Charles W. Burnham: I would like to inquire of Mr. Stevenson whether he considers the increased catch as proof that the number of fish are increasing, or is it due to improved appliances or more fishermen? What is the cause of this increase?

Mr. Stevenson: Of course an increase in apparatus would naturally result in an increased catch, but it is supposed that the fishermen of the interior waters usually prosecute the fisheries as vigorously as their resources will permit.

Mr. Meehan: There has been no marked increase in the number of fishermen from the port of Erie in the last five years. Conditions are approximately the same, both as regards the number of fishermen and amount of twine used. I can positively say that there has been a large increase in the catch of fish.

EXPERIMENTS IN STURGEON CULTURE

By W. E. Meehan,
COMMISSIONER OF FISHERIES OF PENNSYLVANIA.

A few years ago the legislatures of New Jersey and Pennsylvania made appropriations for co-operative work to propagate the sturgeon in the Delaware river. The United States Government exhibited its deep interest by assigning Mr. Livingstone Stone to assist. Pennsylvania's hatching plant on the Delaware, then at Bristol, was made ready under Mr. Stone's direction. One of the superintendents of the Pennsylvania Fish Commission was placed in charge in the field and experienced fishermen were engaged and overlooked by an employee of the New Jersey Commission who had been himself the owner of a fleet of sturgeon boats.

The first season's work, extending over several weeks, was an utter failure. About two dozen large fish were secured, of both sexes. Some were spent, some had hard eggs or milt. Three or four ripe females were captured but at no time were ripe specimens of both sexes caught near enough together to allow the eggs to be fertilized.

Both states made another effort the next year but with no better success. Later, Pennsylvania tried again, alone but without avail. At no time could ripe males and females be obtained at the same time. I understand that the United States Bureau of Fisheries tried elsewhere but with no better success. A despondent letter from the United States Fish Commissioner confirmed me in an opinion that further effort to avert the seemingly inevitable extinction of the sturgeon in the Delaware river would be hopeless.

But an incident at the Torresdale hatchery, Philadelphia, in 1907, revived my hope that perhaps after all discouragement was premature and that there was a possibility that success might be attained. During the shad season of 1906, Mr.

W. H. Safford, then acting Superintendent of the Torresdale hatchery, on a suggestion from me secured 18 short-nosed sturgeon from the shad fishermen and placed them in the yellow perch pond on the hatchery grounds to ascertain how they would do. The fish ranged in size from 18 inches to 2½ feet in length. The pond is about 275 feet long, about 65 feet wide and has an average depth of 5 to 6 feet. It had a muddy bottom and was fed by a small stream which flows through the hatchery grounds and empties into the Delaware. It is also affected by the tide in the river.

The fish were given no food and they had to rely on what they could pick up, yet the following spring they were not only plump and healthy but one of two showed evidence of developing eggs.

At this time Mr. Jerry R. Berkhous had been given permanent charge of the station, and acting under my direction he secured from the fishermen an additional supply of sturgeon, making the number between 80 and 90. An examination showed that the proportion of sexes was over 50 per cent females, at least among those which were far enough advanced towards maturity to make a determination of sex reasonably certain.

The fish were watched carefully and four of the females ripened their eggs, while two males had ripe milt; but as was the case when Pennsylvania, New Jersey and the United States worked together, the two sexes ripened at different times.

During the summer, the sturgeon were fed regularly with liver and corn meal, and grew rapidly. Early in September, 1908, they were transferred from the perch pond to a pond containing white and yellow catfish of mature size. The catfish pond is about 150 by 120 feet and when full of water has a depth of five feet in the kettle and a shelf which shoals to about one foot. The water is supplied by pumping from the Delaware twice a week. For many weeks the sturgeon apparently did as well in their new quarters as they had done in the perch pond. Shortly after the opening of the winter

and the freezing over of the pond, however, there was a sudden change. One day the Superintendent noticed two or three dead sturgeon under the ice and on making an examination he saw a number of others which, though still alive, were evidently in the last throes against the ice in the shoal water. Calling his men he cleared the ice from the pond, drew the seine, and caught all the sturgeon, to find every one either dead or dying.

No satisfactory explanation of this fatality has been evolved. I give the few theories advanced for what they may be worth. One was that they had been driven from the deeper portions, by the more than 700 mature catfish, into the shallower and much colder water of the pond, and that the temperature was too low for their existence. A second was that the entire temperature of the water was too low, there being a difference of about two degrees between the water in the catfish pond and the bottom water of the perch pond. A third was that there was not enough change of water during the low temperature period. Some color was given to the cold water theories by the fact that all the fish still alive when taken from the pond were stiff and with the same appearance as trout kept for any length of time in tanks during very cold weather without vigorous aeration of the water.

When the nets were operated in the river in the spring of 1909 more sturgeon were procured, also of the short-nosed species. This time Mr. Berkhous selected the sexes in the proportion of one-third females and two-thirds males. They were placed in two small ponds where they could be handled easily and gone over each day. On April 9 he found the first ripe female. A few days before he had found several nearly ripe males.

As the female was taken from the water eggs flowed from her without any pressure for a moment and then stopped. On replacing the fish in the water and again removing her, the eggs once more flowed. This fish, which was a little over two feet long, was stripped with the greatest ease, at least of

a portion of her eggs—for it developed that all were not entirely ripe. The eggs were fertilized by the dry method. They were extremely glutinous and numbered about 1,000. Placed in the jar without having been first cleaned, the result was that most of them fungussed and only three or four hatched.

The second ripe female sturgeon was found on April 13th. She was about $2\frac{1}{2}$ feet long and like the first fish did not have all her eggs ripe. As on the first occasion there were several ripe males. The eggs were fertilized as before by the dry method, but immediately after were placed in a pan of muck and water and had to be stirred for more than two hours before they were thoroughly separated. They are extremely glutinous, and although they were extruded easily they issued in small bunches. After they had been worked sufficiently in the muck and water, they were washed thoroughly and found to be non-adhesive unless allowed to lie quietly on each other for some length of time. An examination under the microscope showed them to be covered with protuberances not unlike the spokes on iron jackstraws.

After having been thoroughly cleansed, the eggs to the number of 6,000 were placed in a jar and water turned on to the amount of about one gallon a minute. Even this would not have been sufficient to move the eggs but that it was run in from the second trough above the jar.

The eggs when placed on the battery were of a brown color for about one-half their circumference and a grayish white the other, and during the whole period of incubation there was very little change in the hue. On this account it was difficult to watch the development of the embryo, or to distinguish the good from the bad eggs. When placed on the battery the water temperature was 48 degrees Farenheit, and during the period of incubation it varied between 46 and 54. The eggs hatched on the 26th of April, 13 days after fertilization. The water temperatures from day to day were as follows: April 13, 48; 14th, 46; 15th, 48; 16th, 50; 17th,

54; 18th, 56; 19th, 54; 20th, 50; 21st, 52; 22d, 56; 23d, 54; 24th, 54; 26th, 54.

The eyes showed first on the 19th, six days after fertilization. It was difficult to detect them at this stage owing to the dark color of the eggs. Under the microscope the eyes when they first appeared were light colored but two or three days later darkened considerably and were plainly visible. The shape of the fish was plainly discernible on the 22d, although the outline had been seen several days earlier. The fry emerged from the eggs slowly and instead of rising and floating out into the trough through the lip, sank to the bottom of the jar, where they rested quietly for several days. They were very dark in color and both in hue and general appearance much resembled tadpoles.

The percentage of hatch was very small, only 400 fish being produced from the 6,000 eggs. Mr. Berkhous is of the opinion that this small percentage was not due to failure to fertilize but to cleansing the eggs of the glutinous matter in the muck. From my observations I am in accord with this opinion, for the reason that very few dead eggs appeared within the period when they should, and also from the fact that they fungussed, and fungussed at a low water temperature.

Detection of dead eggs was very difficult on account of the semi-opaque character of the egg itself. It was only by using a microscope that they could readily be distinguished. Under a microscope they showed a white opaque spot.

One of the peculiarities of the work during the period of incubation was the impossibility of siphoning the dead eggs. Instead of becoming light and rising to the top they remained mixed with the others and this may also have had something to do with the death of other live eggs. It would have been possible to separate the good from the bad only by emptying the jar upon a tray and picking them off one by one. The experiment as conducted indicates that better success in hatching could be obtained by using trays instead of jars. In the first place the eggs are so heavy that to move them

requires double the fall of water; in other words, use only every other trough in the battery. In the second place, it is a seeming impossibility to separate the dead from the live eggs by siphoning; and third, the fry go to the bottom of the jar instead of rising and making their way into the trough and thence to the tank.

Mr. Berkhous' experiments were extremely interesting and I regard them as of great value. They do not prove conclusively that the problem of sturgeon culture has been solved. They do not prove that what was done with the short-nosed sturgeon can be done with the common sturgeon. And even if the same methods can be employed with the common sturgeon, this does not prove that the work can be undertaken on a large scale. The experiments nevertheless seem to be in the right direction. Without doubt short-nosed sturgeon can be carried from year to year in ponds 200 or more feet long and proportionately wide and deep, and eggs can be taken safely in sufficient number to warrant fish cultural work. The experiments indicate further that if short-nosed sturgeon can be so carried, the common sturgeon can be carried in larger ponds, its eggs ripened, taken and hatched.

One point, however, seems to be strongly brought out. Even though the fish can be successfully impounded, in order to insure ripe milt and eggs at the same time, there must be a much larger number of males than females kept in stock.

DISCUSSION.

Mr. Dwight Lydell, Comstock Park, Michigan: Have you ever used the Seth Green shad hatching box for hatching sturgeon?

Mr. Meehan: No, but at the time Mr. Stone and others were engaged in the work they used it.

Mr. Lydell: Several years ago we carried on some experiments along this line for the Michigan Fish Commission. We had about 80,000 eggs, and put them in a Seth Green hatching box and hatched out 70 per cent. We found this box very successful for hatching sturgeon.

Mr. Frank N. Clark: Mr. Meehan says the eggs are very heavy. It might be interesting to know that the sturgeon eggs which the United States Fish Commission collected on the Detroit River 25 years ago were very light.

PRESIDENT: May I remind the members of the fact that many years ago Seth Green hatched sturgeon very successfully in his shad hatching box.

Now, as to the matter of heavy eggs handled on trays, is not this parallel to the method of hatching our muskellunge on Chautauqua Lake? There we begin the work in jars, then transfer the eggs to a tray with perforated wires giving a good circulation of water. They hatch very successfully in this way unless left in the jars too long, when the mortality is quite heavy.

MR. MEEHAN: I am well aware that there has been successful hatching of sturgeon eggs. Mr. Stone himself was successful, as was also Professor Ryder. But the principal point I want to make is that it is not impossible to take and successfully impound the short-nosed sturgeon and hold them until they ripen their eggs and milt. The great problem that confronts us, at least on the Delaware, is to get the two sexes at the same time. It cannot be done, at least so far we have not been able to get them, whether early in the spring or late. Our efforts have therefore been directed towards some method of impounding the fish successfully. So far it has been found impossible to do anything with large sturgeon in crates. We could neither ripen the eggs nor could we successfully hold the fish any length of time in cribs. But the taking of sturgeon either just before they were matured or at maturity, and holding them, was the point that we were trying to work out, and apparently accomplished.

MR. FULLERTON: I would like to ask when you found the fish running—was it only in the spring?

MR. MEEHAN: It was in April. We commenced to get the short-nosed sturgeon almost as soon as the nets were put in the river, the latter part of March.

MR. FULLERTON: The fishermen of the locality in Minnesota furnishing most of the caviar, find ripe sturgeon all the year round, and I wondered if that was the case with you.

MR. MEEHAN: We find ripe eggs in April. But referring to the common sturgeon, when Mr. Livingston Stone was engaged in the work and New Jersey and Pennsylvania operated together, we found in July both ripe sturgeon and hard sturgeon, the latter with fully developed eggs but not yet matured.

PRESIDENT: We must not lose sight of the fact that the lake sturgeon is different from the short-nosed sturgeon of salt water.

MR. FULLERTON: I think Mr. Meehan tried both kinds.

MR. MEEHAN: No, only the kind on the Delaware River. We are now gathering Lake Erie sturgeon and putting them in large ponds. We already have half a dozen fish two or three feet long which have been taken within the past two or three weeks.

NOTES ON THE INCREASE IN SIZE OF FISH OVA AFTER WATER HARDENING

By Ward T. Bower,
U. S. Bureau of Fisheries, Washington, D. C.

As the result of a privilege extended to me to draw upon the records of the Bureau of Fisheries, it has become possible to bring to your attention for the sake of comparison and analysis observations made from time to time during the past few years by several of the Bureau's station superintendents with reference to increases in the size of fish ova during the period of incubation. The object in submitting these data is to point out the advisability or even necessity of such considerations, and at the same time to stimulate further investigation of the subject.

The expansion of fish eggs during water hardening is of no particular concern to the fish culturist as regards volume other than that receptacles of sufficient capacity be provided. This absorptive period coincides with the adhesive stage, covering the early processes of segmentation, when the eggs are extremely sensitive and should not be handled. It is when this sensitive period is past, and at the time they are ready to place in the hatching equipment, that measurement becomes a matter of importance. Heretofore it has been generally considered that from this stage of development there was little or no further increase in size throughout the period of incubation.

The prevalence of this erroneous idea is rather strikingly evident from the fact that fish culturists in computing the losses, the output of eggs, and the number of fry hatched, have not until recently taken into consideration, or at least made any allowance for, an increase. This was all in favor of the fish culturist's record, but lacked accuracy, as the output of fish was frequently determined by a volume meas-

urement of the eggs in their later stages, with the same standard that was employed near the beginning of the period of incubation. This condition was, of course, somewhat mitigated in those instances where eggs well eyed were transferred to other stations for hatching and a new standard of measurement was adopted at the station receiving them. However, until recently the fact of there being an increase has received little or no recognition, or at least but slight practical application.

During the last few years various tests and measurements have afforded a definite basis for discarding the old theory. We may, in fact, boldly advance the statement that probably most fish eggs increase in size, not only during the early absorptive period but continuously up to the time of hatching. For a number of species this fact has been demonstrated. Rainbow trout eggs have shown, in the tests, practically no increase. But all other species tested have exhibited varying degrees of growth, in the whitefish reaching 15 per cent.

A resumé of the observations made at a number of the Bureau's stations will show the basis of these conclusions.

WHITEFISH.

During the winter of 1906 Superintendent Downing of the government station at Put-in Bay, Ohio, made some very interesting observations as to the increase in size of whitefish eggs. Various lots were counted from time to time and it was quite conclusively demonstrated that the eggs enlarged in size more than 15 per cent. It was further shown that the rate of increase was quite unnoticeable at first, but the older the eggs the more rapidly they grew. In the winter of 1907 the use of the von Bayer gauge and chart showed that green whitefish eggs ran 42,000 to the quart, and eyed eggs 36,000 to the quart, a bulk increase of approximately 14 per cent.

Superintendent Green, of the Cape Vincent, N. Y., station, noted that whitefish eggs increased 3 per cent in size during the month just prior to hatching. This seems to corroborate the observations of Mr. Downing that the increase largely

occurs in the more advanced stages of the period of incubation.

PIKE PERCH.

At the Put-in Bay station Superintendent Downing carefully counted and measured a lot of pike perch eggs 3 days old, and found that they numbered 171,680 to the quart. When fully eyed 13 days later, but 157,024 eggs from this same lot could be placed in a quart measure, thus showing an increase in bulk of over 8 per cent. Since that time tests with the von Bayer gauge showed the pike perch eggs to measure 180,000 per quart when green, and 150,000 when eyed, a bulk increase of over 16 per cent.

Experiments conducted at the Swanton, Vt., station, under the direction of Superintendent Carter, showed such an increase that two measuring scales were adopted—one for green and one for eyed eggs. The latter allowed for an increase of approximately 11 per cent.

CHINOOK SALMON.

Chinook salmon eggs have been reported upon perhaps more in detail than any others. During the past year Superintendent Lambson, of the station at Baird, California, made some very significant tests to determine the growth of the chinook eggs from the time of water hardening until they were well eyed. Mr. Lambson describes his method of making the tests in substance as follows:

On November 10, 1908, 20 dippers of eggs were measured into a hatching basket. The dipper was of 27 ounces capacity, and there were thus 540 ounces of eggs in all. They ran 74½ to the ounce, making 40,230 eggs in the lot. On January 13, 1909, remeasurement showed 575 ounces of eggs, which at the same count per ounce would have made 42,837 eggs. There had been a loss of 1951 eggs while in the basket, which brought the number up to 44,788. The actual increase in bulk, in terms of eggs counted at 74½ to the ounce, was thus about 4,558. That is, there was an increase in bulk equal to that many eggs of the original size, or a trifle over 10 per cent.

Two other tests, made at the same time and under exactly similar conditions, with the same number and size of eggs, showed increases of 12.68 and a trifle over 11.75 per cent. Great care was used, Mr. Lambson states, to have "struck" measure of the dipper in every instance, and the count of eggs, to the ounce also was carefully made.

The same plan of observation was followed at the Battle Creek and Mill Creek, California, stations, with full confirmation of the results obtained at Baird. From six different lots of eggs an average increase in bulk of over 10 per cent was recorded. In one case it ran as high as 16¼ per cent.

LAKE TROUT.

Lake trout eggs have been tested for increase in size at Duluth and at Northville. At Duluth, on November 19, 1907, a quart of green lake trout eggs was selected as nearly as possible for uniformity of size. These eggs were divided into two equal lots one of which was counted and found to contain 2,869. The other lot was placed on a separate tray. Whenever an egg of the first lot died it was removed and replaced by an egg from the second tray. On February 19, when the eye spots were first visible, it was found that only 2,694 eggs were required to fill a pint measure, thus showing an increase in size of 6 per cent. Just before hatching, April 11, the eggs were again measured, but showed no further increase.

Superintendent Clark states that at the Northville station lake trout eggs are found to increase in size from the green stage to just before hatching from 215 to 185 per fluid ounce, i. e., 14 per cent.

BLUEBACK SALMON.

A lot of blueback salmon eggs, according to Superintendent Hancock, of Yes Bay, Alaska, at the completion of water hardening measured 4,416 to the quart. Five weeks later the same eggs measured 4,160 per quart, and at ten weeks of age they had increased approximately 9 per cent,

numbering 4,000 per quart. They were counted and measured in a 32-ounce graduate. Tests since made with the von Bayer scale showed the increase to be considerably less.

BROOK TROUT.

In regard to brook trout eggs the records show an increase of from $2\frac{1}{2}$ to 10 per cent. Measurements made by Superintendent Robinson at the White Sulphur Springs station, West Virginia, gave an average increase of $2\frac{1}{2}$ per cent. These figures are conservative, and it is probable that the increase was somewhat greater, for some of the tests indicated an increase in bulk of 8 per cent up to the time of eyeing. Mr. Robinson is of the opinion that there is not much increase after the eggs are fairly well eyed to the time of hatching. The tests were made both by means of the displacement of water in a graduated glass tube, and by the von Bayer gauge.

At South Chittenden, Vermont, brook trout eggs increased in bulk from 365 to 340 to the ounce, approximately 6 per cent; while at Spearfish, South Dakota, Superintendent Booth recorded a 3 per cent increase, the latter tests being made both by the von Bayer gauge and by actual count of a few ounces taken in a graduate. An increase of 2 per cent or more was noted by Superintendent Dean, at Neosho, Missouri, and a 4 per cent increase was recorded by Superintendent Henshall, of Bozeman, Montana, the latter test being made with the von Bayer gauge. Observations by Superintendent Thompson at Leadville, Colorado, indicated increases varying from 5 to 10 per cent, and while Mr. Thompson was at the Nashua, New Hampshire, station, he recorded an increase of approximately 10 per cent.

LANDLOCKED SALMON.

As to landlocked salmon Superintendent Race of the Green Lake, Maine, station, finds a slight increase during the period of incubation, tests made with the von Bayer gauge showing this to be approximately 1 per cent. Measurements

with a common apothecary's graduate showed no noticeable difference in the size of the eggs.

RAINBOW AND STEELHEAD TROUT.

With a view to ascertaining the increase in the size of rainbow trout eggs, careful measurements were made several times during the period of incubation of a particular lot of eggs at the Manchester, Iowa, station during the winter of 1906. These measurements demonstrated a slight increase from the time of water hardening until the eighteenth day—324 temperature units—and then a slight decrease until the thirty-second day—516 temperature units. It is the opinion of Superintendent Johnson, who made these interesting observations, that there is a slight increase in the size of rainbow eggs from the beginning of segmentation until the eye spot clearly appears, which usually takes place at about 285 temperature units. After this time there is a gradual decrease in size, the egg being slightly smaller at the time of hatching than at the time of fertilization.

Until a development of about 396 temperature units is reached the membrane of the egg is firm, after which it so increases in softness and tenderness that it cannot be handled without danger of breaking. At this period the egg is very susceptible to slight pressure, its own weight when it is taken from the water tending to a pronounced flattening. It is largely as a result of this softening that it loses the uniformly spherical contour of the earlier stages, and becomes more or less elongated and irregular. In the advanced or soft stage the eggs naturally lie very close together when measured in a graduate and this possibly accounts for the apparent slight decrease in the size just before hatching.

In addition to determining results by the ordinary graduate measurement, Mr. Johnson drew his conclusions from a measurement of the bulk of the eggs by water displacement in a graduated glass tube. This method he considers to be much more accurate, especially in its application to this species of eggs.

Superintendent Robinson, of the White Sulphur Springs station, in West Virginia, has made careful tests with a graduated glass pipette vertically placed to determine the water displacement, and finds a slight decrease in the size of rainbow trout eggs during the period of incubation. Superintendent Seagle's measurements, at Wytheville, Virginia, indicated a slight increase—a trifle under 1 per cent—while at Erwin, Tennessee, Mr. Keesecker, using the von Bayer scale, showed about the same slight increase as at Wytheville.

It thus seems to be shown that for practical purposes there is very little or no increase in the size of rainbow trout eggs during the period of incubation. The peculiar character of these eggs at a certain stage, however, makes measurement difficult and suggests the need of further study of the subject.

Steelhead trout eggs have been carefully measured by Superintendent O'Malley, at the Baker Lake, Washington, station, and showed an increase of 9 per cent. A similar increase was observed also at the Bozeman, Montana, station by Dr. Henshall.

LOBSTERS.

Lobster eggs show a greater increase than any of the fish eggs. At the Gloucester, Massachusetts, station Superintendent Corliss noted that between February 6 and May 1 a given lot of lobster eggs increased from 11 to 13½ ounces—over 20 per cent. It is a peculiar fact that a few days before hatching lobster eggs swell to three times their original size. The variation in the size of good lobster eggs, even from the same parent, is often quite remarkable, some being three times as large as others. Superintendent Hahn, of Boothbay Harbor, Maine, states that the increase in bulk during incubation is not so noticeable at his station as Mr. Corliss has found it at Gloucester, but Mr. Hahn's experience shows an increase varying from 5 to 15 per cent.

CONCLUSIONS.

Reviewing the results of the various tests and measurements, we find the following average increases in the size of the several species:

Whitefish	15 per cent
Pike perch	8 and 11 per cent
Chinook salmon	11 per cent
Brook trout	5 to 10 per cent
Blueback salmon	9 per cent
Lake trout	6 to 14 per cent
Landlocked salmon	1 per cent
Rainbow trout	0

Lobster eggs apparently increase in size more than any of the fish eggs tested, the figures being 15 and 20 per cent for the period of incubation exclusive of the final swelling just prior to hatching.

In presenting these figures, preference of course is given to actual count. Measurement by water displacement is doubtless second for accuracy, and is recommended as against the von Bayer gauge, for the reason that the latter depends for its accuracy upon uniformity in the spherical outline of the egg, whereas individual eggs of all species vary in this respect and there is often further variation when the eggs are out of water, due to softness or weakness of the membrane. The graduated scale or stick, applicable only to jars of eggs, and the measurements by weight have not been specially considered here, probably being less accurate than the other methods mentioned. Aside from actual count true determinations would perhaps best be made with a micrometer applied to eggs which have been carefully treated with proper killing fluids, their normal size and shape being thus preserved. This method, however, is not ordinarily within the reach of practical fish culturists.

With due allowance for inexactness, the figures obtained establish one important fact—namely, that after water

hardening there is an increase in the size of certain species of fish eggs so considerable as to call for recognition in practical fish culture. An output of nominally 100,000,000 eyed whitefish eggs, for instance, measured when eyed and computed by the usual standard for green eggs would add 10,000,000 to 15,000,000 to the actual number planted. Reports may thus unwittingly or unintentionally be increased by many millions.

In addition to their practical significance, these percentages suggest the possibility of other interesting developments. The rainbow trout egg, it seems, has peculiarities which, so far as the present data are concerned, removes it from the considerations applicable to the other species tested. Its near relative, the landlocked salmon, shows little increase in size, if any, after water hardening, and further tests may be expected to show closer similarity of characteristics between these two. It would be of interest to know what characters in the eggs control or accompany the varying degrees of expansion. Have the semi-buoyant eggs, which are kept constantly in motion, greater absorptive power than the heavy eggs, which remain practically unmoved during incubation? Is the increase due to absorption of water, or is it perhaps, a physiological growth? Answer to these questions is possibly to be found in biological literature, but in the various authorities I have consulted there is a striking absence of any mention of increase in size of fish eggs after the early segmentation stages. The question is one well worth further investigation.

DISCUSSION.

Mr. Frank N. Clark: I question a 15 per cent. increase on whitefish, as I do not think the tests of one year sufficient for definite conclusions. I would like to see the investigations carried on for several years. Mr. Downing's experiments, no doubt, covered just the one season of 1906. While we never have made exactly similar tests, I think in measuring with the von Bayer gauge we found about the same number at all times of the season. Notwithstanding Mr. Downing's experiments for one year, I doubt whether it can be established that from the time whitefish eggs are thoroughly water hardened, say when four or five days old, there is this increase in size when they are two or three months old. However with lake trout eggs it must be confessed that our measurements for several years have shown quite an increase.

Mr. S. W. Downing: If I remember correctly, I made two experiments. The first was by actual count and the second by means of the von Bayer gauge. The results are as stated by Mr. Bower.

Mr. Clark: Both the same season?

Mr. Downing: Not the same season. The count was made before I knew of the von Bayer measure. I would like to say in summing up Mr. Bower's paper that it looks a little misleading as regards the number of fry we actually put out. The eggs are measured into the hatchery on the higher standard, 42,000 to the quart, but as they increase during incubation the hatching is done on a 36,000 basis. So we plant just as many fry as we say we do.

Mr. S. F. Fullerton: I find that the difference, especially in pike perch eggs, is very noticeable. We have one station where by actual measurement they did not exceed 120,000 to the quart, but at Tower where the fish are all small, not averaging more than a pound and a half, our men counted as many as 185,000 per quart. There was a difference of 65,000 by actual count.

Mr. Clark: Of course that is not exactly the question here. Those eggs were from different waters and taken at different times. The same difference occurs with whitefish, for if I remember correctly it is very noticeable in whitefish eggs taken in upper Lake Michigan. These run only about 30,000 to the quart, being much larger than those from Lake Erie.

Mr. Fullerton: The reason I brought the subject up is that I just asked Mr. Titcomb in regard to the Federal standard for measuring pike perch eggs. It is difficult to fix a definite standard if the other states have had the same experience that Minnesota has.

Mr. John W. Titcomb: At an earlier meeting of the Society I endeavored to point out the value of the von Bayer measure. You cannot make a standard for any of the smaller eggs nor in fact for the larger eggs. It has been my experience that with almost all species there is a variation in the size of eggs between one field and another,

even on different parts of the same lake. In the trout work the eggs from one stream will be very much larger than those from another; likewise early in the season the eggs will be smaller than during the height of the season; and as the season tapers off the eggs are again smaller. There is great lack of uniformity in size. Of course this is not in a way relevant to Mr. Bower's paper on the growth of eggs. It merely emphasizes, as his paper does, the necessity for establishing a standard. If you want to know how many green eggs you get you must establish a standard for each station where eggs are collected. Then if you are going to judge the hatch by the number of eyed eggs on hand, you must establish another standard for each species and field from which the eggs are taken.

Mr. Fullerton spoke about the larger eggs coming from the large sized pike perch, and similarly in that part of the Manual of Fish Culture where Mr. Clark is the authority, it is stated that the larger trout eggs are obtained from large fish. In my personal experience at several field stations I got the smallest trout eggs from the largest fish. They were from trout ranging from two to five pounds in weight and ran 500 to the ounce.

NOTES ON THE YELLOW BASS

By Charles W. Burnham,
U. S. Fisheries Station, Tupelo, Mississippi.

The yellow bass (*Morone interrupta*) is found in the lower Mississippi Valley, and north to Cincinnati, St. Louis and Terre Haute. It is most abundant in such streams as the St. Francis and White rivers in Arkansas, which are noted for their clear water and clean gravelly or sandy bottoms.

Its color is brassy yellow, darker on back, growing lighter on sides and below, with about 7 very distinct black longitudinal lines. Head depressed, eye large, mouth small, back arched, body comparatively long, flesh firm and white.

It is a splendid food and game fish and compares favorably with the black bass. It is often confounded with and resembles the striped bass of salt water, and the white bass of fresh water. In many places it is known as striped bass or barfish.

The average lengths attained by yellow bass under favorable conditions are as follows: 3 weeks old, 1 inch; 6 weeks old, 1½ inches; 3 months old, 3 inches; 8 months old, 6 inches; 1 year old, 8 inches. The adults usually seen weigh from 1 to 2 pounds, but some caught have exceeded a foot in length, and weighed over 5 pounds.

Young yellow bass are as delicate as crappie, and those less than 2 inches long cannot be handled in warm weather without loss, but like crappie the yellow bass successfully withstand a water temperature higher than 90 degrees if not handled.

When seined from the water fingerling yellow bass bend into a semi-circle as if trying to touch head and tail together. In this position they rapidly become rigid or stiff and die

unless promptly placed in water. Upon being returned to the water they soon straighten out and swim around as usual. The adults do not have the tendency to curl up so much as the young fish and struggle more like other species when removed from the water. Yellow bass are very timid and it is necessary to conceal oneself in order to observe them closely.

The spawning season is in April and May, depending largely on the water temperature, the height of the season being from April 15 to May 15. Spawning takes place about midday, on bright calm days when the water temperature ranges from 68 degrees to 72 degrees, in water from 2 to 3 feet deep.

As the spawning time approaches the fish instinctively swim up stream in search of the purest water. Preliminary to spawning they pair off and swim swiftly along side by side, the male about 3 inches away from the female, both appearing to be much excited. When spawning occurs the fish swim very slowly or stop for a few seconds while the eggs and milt are being emitted.

In the act of spawning the female lies partly on her right side with vent toward the male, ejecting the eggs with a tremulous or wavy motion of her entire body. The male does not lie sideways but remains upright beside the female, so that his vent is directly over the eggs as they come from the female. He ejects the milt on the eggs without any perceptible movement of his body except as necessary to maintain his position beside the female. The eggs are not all voided at once, and the fish swim around together during the interval between spawnings, which continue for an hour or more. After spawning the fish usually remain still near the bottom for some time as if resting.

The eggs are not likely to be all matured at once, therefore the spawnings are probably continued on different days as the eggs develop. The eggs are semi-buoyant and slowly sink. Many of them are eaten or smothered, or are unfer-

tilized when they reach the bottom. Thus yellow bass are not so prolific as black bass and other nest-building pond fishes, which deposit their eggs and guard them until hatched. With yellow bass 100 brood fish per acre are necessary for a good output of young fish.

The eggs are very small, being about .03 of an inch in diameter, or from 2,000,000 to 2,500,000 per quart. The period of incubation at a mean water temperature of 70 degrees is from 4 to 6 days, and the yolk sac is absorbed in about 4 days. When first hatched the fry are from 1/8 to 3/16 of an inch in length, colorless and transparent, the first color to appear being the black eye spots.

Owing to the yolk sac the newly hatched fry are far easier to see than those a few days old, because after the yolk sac is nearly asborbed the fry are only 1/4 of an inch long, very transparent, and much more slender. Their small size and transparency are doubtless of considerable protection to them.

The movements of the young yellow bass differ from those of young black bass, but both accomplish the same purpose, i. e., protection from being smothered in sediment. The black bass fry swim forward near the bottom in a horizontal position by energetic movements of the caudal fin. The yellow bass fry rise straight toward the surface head first by vigorous movements of the tail, and when their exertions cease turn quickly and sink head first to the bottom without moving the body or fins while descending. Touching bottom they immediately turn and swim upward again, occasionally stopping before reaching the surface. The habit of incessantly swimming up and sinking slowly to the bottom is probably instinctive, and protects the fry from being suffocated if the bottom is muddy.

When first hatched the fry may be seen when they swim up near the surface in water about two feet deep. After 2 or 3 days they drift toward the shores and can be found in water from 1 to 10 inches deep.

About 4 days after hatching the yolk sac is completely absorbed, and the fry have ceased swimming straight up and dropping slowly to the bottom. They now swim slantingly upward and then downward in the same manner, and when they have reached the bottom, instead of instantly starting up again they pick at small particles and remain at the bottom in a horizontal position for several seconds nibbling around in search of food. The fry are now ¼ to 5/16 of an inch long, colorless and transparent, with the exception of the minute black eye spots, and can be seen only by the very closest observation.

After they begin feeding, the fry grow rapidly, reaching a length of one inch in about 3 weeks. They swim around in schools, and grow very uniformly in size, and are therefore not so destructive to each other as are black bass, which fact offsets to some extent the greater productivity of the black bass by reason of its spawning habits.

The natural food of the fry and fingerlings is air and water insects, crustacea, insect larvae, small fishes, and other forms of life found in water. The natural food of the older fish is air and water insects, crawfish, crustacea, frogs, molluscs, small fishes, tadpoles, worms, etc. At the Tupelo, Mississippi, station the adult yellow bass readily ate raw beef hearts, livers, and steaks, cut into strips resembling angle worms. At this station yellow bass are propagated in ponds by natural consort of the sexes, and the fry are reared to fingerlings before being distributed.

Because of their spawning habits and natural inclination to frequent the deeper places, yellow bass thrive best in large bodies of clear pure water. They do not reproduce well in muddy surface water ponds, nor in roily ponds having earth bottoms without gravel or vegetation. That is one of the principal reasons why yellow bass are so abundant in the St. Francis and White rivers, the water being clear and bottoms gravelly or sandy, the eggs are not smothered, and the waters are so extensive that not many of the fry are eaten before they grow large enough to escape from their enemies.

DISCUSSION.

PRESIDENT: You have heard this rather novel description of the yellow bass. Before the general discussion opens I would like to know for a certainty whether Mr. Burnham can say positively that this species reaches a weight of five pounds.

MR. BURNHAM: No; the statement is taken from Jordan & Evermann's work. The largest I have seen personally were about a foot in length and weighed from two to three pounds.

PRESIDENT: The fish in question is very closely related to the common white perch of the east, and both have incredibly small eggs. The maximum weight given seems to me to be above that generally reported, but Dr. Evermann is here and I have no doubt he can give us a statement as to the size of the white perch of the Mississippi region.

DR. BARTON W. EVERMANN, Washington, D. C.: I do not recall now the data which were used in giving the weights named. All I can say is that I think the matter was looked into pretty carefully at the time, and there was fair justification for the conclusion. I never saw one that large myself.

MR. WARD T. BOWER: Mr. Burnham makes the statement that the eggs measure from two million to two and a half million per quart. I believe it would be interesting for the Society to know how he arrives at those figures. It seems rather incredible that the eggs should be so extremely small.

MR. BURNHAM: I have two authorities besides myself. The Manual of Fish Culture in describing the flat fish, I believe, states that the eggs measure 30 to the lineal inch or about 50,000 to the ounce or 1,600,000 to the quart, and the yellow bass eggs are still smaller. They measure 33 1-3 to the lineal inch, therefore my estimate of 2,000,000 to the quart is not excessive. Superintendent Stapleton, of the Mammoth Spring, Arkansas, station, took eggs of this species from the White River for the purpose of hatching them artificially. By the von Bayer gauge and scale he figured them at 2,500,000 to the quart, but I wished to be conservative, so I stated that they ran from 2,000,000 to 2,500,000 per quart.

MR. WARD T. BOWER: Then the matter stands as to whether the von Bayer gauge is a proper instrument for determining the size of the eggs?

MR. BURNHAM: Yes.

MR. BOWER: You based your conclusions on the fact that the eggs were only .03 inch in diameter?

MR. BURNHAM: Yes.

MR. BOWER: In regard to the von Bayer gauge, I believe that adhesive attraction has a great deal to do with the measurement of eggs by that device. If eggs are placed in a little water on a flat surface, on a piece of glass, for instance, they will all run together. Naturally there must be a slight compression. Therefore I question whether the von Bayer gauge is a true index of the diameter of the eggs, particularly those having a soft membrane.

MR. TITCOMB: I think the von Bayer gauge is a pretty good rough measure in the field, and I believe Mr. Burnham is right when he says

that yellow bass eggs will go from two to two and a half million to the quart.

In connection with recent efforts to propagate the white bass in Arkansas, three yellow bass were spawned by hand in the usual way, the eggs being placed in jars. They hatched in five days at a temperature of 50 degrees F. There seems to be no reason why these eggs cannot be artificially taken and hatched in jars. Incidentally at the same place where the yellow bass were spawned by hand, two crappie were stripped and the eggs also hatched in a jar, the period of incubation being the same. They seemed to have many of the characteristics of pike perch eggs, but were not so adhesive, and there was not so much difficulty in handling them. I wish Mr. Lydell would tell us something about the white bass work done by him.

Mr. Dwight Lydell: In 1890 I was sent by the Michigan Fish Commission to Wisconsin to experiment in hatching white bass. The eggs were incubated in jars and I had no trouble in getting a hatching percentage of from 35 to 40. However, we experienced great difficulty in taking the adult bass at spawning time. We found places where thousands of them came to the shore early in the morning to spawn, but when seined up we had nothing but male fish. In the evening it seemed that nothing but females came in, so we set gill nets out in 20 feet of water, and nearly all fish caught were ripe females. The eggs were easily fertilized by males caught in the morning, and we had no trouble in hatching them. We figured white bass eggs at one and a half million to the quart. We took about 20,000,000 and had no trouble in transporting part of them to Michigan. We turned some of them over to the Wisconsin Fish Commission and the fry were planted, I think, in Ashland County waters. We operated during the month of June on Lake Minocqua and Lake Mendota, also on Lake Winneconne and the Winneconne River. The fish spawned at a temperature of 62 degrees to 70 degrees F. The records are in the office of the Michigan Fish Commission and will show exactly what we did. We had no trouble in hatching the eggs in jars or in stripping the fish. They were the easiest fish to strip I ever handled. The males resembled yellow perch in that the supply of milt was abundant. As an experiment we seined up several thousand white bass and put them into an enclosure in the creek. This enclosure was about 200 feet long and the full width of the creek, 30 to 40 feet. However, we were unable to take any eggs in this way.

THE ECONOMIC VALUE OF THE SPORTSMAN

By Andrew Price,
MARLINTON, WEST VIRGINIA.

I am glad that I have an opportunity of maintaining before you that, in the severely practical, scientific world to which you belong, the sportsman has the right to exist and that this right does not depend entirely upon the law of fang and claw.

When I joined this honorable body of scientists some years ago, I did not appreciate the high aims of the Society. I fully expected to find here what Isaac Walton calls "brothers of the angle." But I soon found that that arch destroyer of fish would not have been admitted to temples sacred to the life and health of fish and that his writings as to the most deadly lures and methods can only be classed as "murder as a fine art." I found here a society of serious minded men whose whole lives are given to the business of propagating fish and who have little patience with the recreation that poor suffering humanity gains in the pursuit and death of the inhabitants of the waters.

Levity is not encouraged and I find myself to be the sheep-killing dog in the company of shepherds. Better men than myself, however, have made this mistake. At the meeting of the International Congress of Fisheries at Washington last year, a cabinet officer in giving his address of welcome attempted to perpetrate a pun, which was received with a funereal silence which must have been very disconcerting to the gentleman. He turned pale and realized that he had committed a solecism that would return to him in the stilly night as he lay upon his restless pillow in after years. He said that one of our great fishes, the cod, was of so much importance that its name had a national significance, meaning thereby, C. O. D., but the joke was a child of his imagination destined for his express company, for the scientists

there assembled would have nothing to do with it. A pained expression prevailed upon the face of his audience, very much as though an old and venerated pastor had suddenly launched into profanity from the pulpit. The newspapers next day kindly refrained from mentioning the uncanny occurrence, but I venture to say that he will never forget it as long as he lives.

Now, gentlemen of the Society, permit me to say that this preternatural gravity belongs more to the Weather Bureau than it does to you, for your position is too well assured and your work too important to be dispensed with, and I would rather see you when you take these precious vacations from the constant care and supervision of your work, decide to eat, drink and be merry, and not stifle that saving grace of humor, the proud heritage of the American people. If I had my way I would see that the cabinet member was given a Carnegie medal for bravery.

Now I would ask you to give us who fish to forget our troubles, a place in your scheme of life, and an opportunity to be heard in your deliberations.

I believe that it has been definitely settled by Congress, that there is no consumer, or rather that we as a nation are producers, and the consuming part of our lives is but incidental to the main objects. That if there be a class who do not produce, but only consume, they have no rights that the country is bound to respect. Not so with us, who in return for our predatory habits give as much time and help as we are capable of to aid you in your great and important work.

A certain great lawyer of my state, the general counsel of one of the great railroads of the country, who has risen to the top of his profession, was once talking with a young lawyer who had just begun to practice, but who had high ideals. The young lawyer said he hoped that when he became fifty years old to have accomplished much in his profession; that by that time he would be able to fill certain offices of great honor and trust, so that his life would be a success and of great use in the world. The older lawyer said that he also

had made certain definite plans as to his life when he became fifty years of age; that he hoped at that time to have saved enough money to insure him a competence the rest of his life, in which event, he intended to do nothing but fish the rest of his days. The young lawyer looked disgusted.

I am sorry to add that the young lawyer after a few years of strenuous endeavor was called hence to be no more, and the older lawyer has pursued the even tenor of his way and after a hard day's work retires to his den to be with the most elaborate of outfits of fishing tackle, to dream of the good time coming when he can retire from a profession where one sees the worst side of human nature, and engage in his favorite sport, living the calm and contemplative life of the angler.

I very much fear, for the sake of the soul of this man of high ideals, that this good time a-coming will never be reached, for the way to go a-fishing is to do it now, and such a future existence as he plans will be about as hard to come up to as the proverbial rainbow's foot which we have all been trying to find.

Most of us elderly sportsmen, anyway, have most of our fishing in our heads, and when we dream of babbling brooks and the shade of the streams on a summer's day, we lack the power of execution, having the will and not the power to destroy. Theoretically we are fishermen, but most of us have reached that place best described as our anecdotage. We vainly cry: "Give me but a fishing line, and set me on the streams of West Augusta, and I will gather me a bunch of trout, which will lift my bleeding spirit from the dust, and set it free!" We go on with our work, getting farther and farther from the healthy outdoor life, and our brothers of the angle, till an alien turf enfolds us; we die and none can tell them how we died. And yet,

> Perhaps some hoary-headed swain may say,
> Oft have I seen him at the early dawn,
> Brushing with hasty steps the dew away,
> To catch a sucker he had fixed his thoughts upon.
> Oft have I seen him by some sleepy brook,
> Beneath the shade of overhanging trees,

> A jug of wine, a fishing pole, a book—
> Waiting for nibbles in contented ease.
> Oft have I seen him at the set of sun,
> Wind slowly home by devious ways at night,
> Clasping in ecstacy a sucker one,
> And sink to rest before the tavern hove in sight.

But note it is only the hoary-headed swains can tell about this, for the average fisherman sows his wild oats in the days of his youth and as he gets older reforms and only glories in his past wickedness. To hear him talk you would think that he could still make his hand at fishing, but in truth and in fact, most of us old retired fishermen are really frauds, and we lack the time, the inclination, the skill and energy to make a real fisherman. We can very well remember the times when to get the mountain trout we would suffer all the peril and privation of an explorer. We would penetrate the wilderness and reach some rough brawling mountain stream, and sleep out on the hard ground and say we liked it. But with age comes disinclination to rough it, and sleeping on the ground has lost most of its charms. The air which comes over the yard fence and through the window screens has all the ozone that we require, and when we claim that we can still make a hand at fishing, the truth is not in us. We are back numbers when it comes our time to make good.

Perhaps to make this thesis more valuable and convenient as a reference work, we should treat the subject by subdivisions, and we will therefore consider the economic value of the sportsman from the following viewpoints: (1) As a faker; (2) as a spender; (3) as a producer; (4) as a protector.

The faker is generally a sportsman who in his early days was a well-known terror to the game fishes of his habitat. In the winter or at any time when his particular prey is not in season, he is longing for the time to come when all legal bars will be down and he can go a-fishing. At these times, this animal, being provident by nature, lays in great supplies of fishing tackle and spends much time and money. His thoughts and his conversation turn to his favorite sport at all

times and he is a considerable pest to the community. He admits that in recent years he has neglected his fishing shamefully, preferring flowery beds of ease, but he swears by all the big and little fishes that when spring comes again and the fish are on the bite he will do nothing else but fish. The spring time comes and he falls into a curious kind of indolence known as spring fever. He puts off going fishing from day to day and drags through the work at the office. He takes less interest in the talk of fish and hastily admits that he has not wet a line this year. He idles away the summer time and along about three days from the end of the season he makes a wild dash for the fishing grounds.

Arrived there he finds that his hand has lost its cunning. He tears his clothes and breaks his fishing tackle. He dashes his foot against a stone and falls down in the cold water. His bones are soft and he suffers from rheumatism. If he is very, very wicked, he seeks consolation in the flowing bowl. The fish refuse to respond. He gets tired, cold, wet and miserable, and he knows that he is aging. He remembers with regret the summer frittered away in the sordid cares of business. He accuses himself of degenerating from a noble animal to the level of a common work horse. Six days at the office trying to get the better of some other men, and his Sundays passed in slumber in his comfortable pew. He resolves never to neglect his fishing again, but every year the work habit is more securely fastened upon him and he never gets back his lost heritage. He will not admit it however. He will still claim to be a fisherman and any day except in the season, he will boast and brag of his powers. For him, "each year brings less summer cheer, cramps more his ineffectual spring, and something earlier every year, his singing birds take wing." Am I not right in classing this sportsman as a faker?

But contrast this man with the one who never lets business interfere with his fishing. He is after the fish from early to late. He speedily gets used to the hardships of his favorite sport. His face bronzes over and his muscles harden and he

soon becomes strong in body and in mind. He is given the active mind and he can accomplish in fifteen minutes more effectual work than his sluggish adversary is capable of in any time. He is fitted to write a book, paint a picture, try a law suit, perform a marvelous surgical operation, make a fortune, woo a bride, or perform any other great work he sets his mind upon, and when after a hale and hearty old age he winds up his line for the last time, and is gathered to his fathers, they carve upon his tombstone: "His life was fair and level and when death had set him free, he said, 'I see the devil, but he can't get me.'"

We find that this man is a good example of the spender, and as such plays an important part in the scheme of life. Ask any citizen of Maine or Florida, as well as many other delightful countries, and they will tell you that the most important crop which the people work is the tourist crop. His is

> A legion that never was listed,
> It carries no color nor crest,
> But split in a thousand detachments,
> Is breaking the road for the rest.

Legislatures meet in honor of the tourist and railroads bow to his princely will. The city clerk who spends eleven months in a hall bedroom, and who trembles with fear at the frown of the manager, can buy himself a lance-wood fishing rod and travel to some distant fishing ground, and pass as a potentate among the good people he finds living there. I have seen such a scion of city life tip a rich farmer to the extent of a quarter with a lordly air, and the tip was thankfully received and pocketed. That farmer could have bought up a regiment of such men and was an influential man in his county and state. The tourist had here a taste of what it is to belong to the nobility, and though he had to return to the state of slavery into which he had voluntarily sold himself, he could return with a head held high, spurning the ground on which he walked. He could at least have said that he lived. He had also the satisfaction of knowing that he had left that

quarter in a safe place and that it never would do any more harm as a part of the root of all evil.

I have observed the genus tourist, from the days when I have turned an honest penny by supplying him with bait and showing him where to find the fish and catch them, up to the point when being in a strange country and yielding to a propensity to catch fish, I have been classed as a tourist myself, and been considered legitimate prey for anyone who could separate me from my money.

Those tourists who cannot very well afford it, as well as many who can, are very apt to employ a man known in season as a guide. Guides out of season are generally hired men and fellow citizens. Their duty seems to consist in supplying their master's creel, and loafing along the creek. Ever and anon the guide's voice will come floating over the willows: "Have you ketched airy one yet?" And the tourist will shout back: "No, but I had a bite!"

And for such inexperienced idiots the soda mines of the country work day and night to supply him biscuit.

It is not all of fishing, however, to fish. The tourist goes back home with a sunburn that is cheap at any price.

The tourist has a hard time of it. If he does not catch any fish he is classed as a fool for spending his time and money in a vain pursuit and if he catches a lot of fish he is named a fish hog. He is condemned if he does and he is condemned if he does not. Way down in the heart of each one of us, lies a secret belief that all game is made for our particular use and for none other.

The visiting sportsman, being comparatively harmless and easy money, has an economic value that is very great. In a mountain country such as the one in which I live he is of much importance. No protective measure aimed at the summer boarder's sport has a chance of passing a vigilant legislature. We welcome him as a coming guest with a pocket full of money and speed him as a parting guest when he goes without the fine, large, juicy wad of money which he brought into the country.

As a producer the sportsman is rather unreliable. When unexpected company shows on the horizon and the good wife has nothing to set before the guest of high quality, it is considered the proper thing for the man of the house to go out with his rod and return with enough game fishes for a meal —catching ourselves a mess of fish, in other words.

In West Virginia there is a noted family of hunters and fishers known as the Hammonds of Bug Run. Old Jess Hammond was born in Kentucky, and seeing the clouds of war gathering, refugeed to the forks of Williams River in the heart of a great wilderness, there to take up the life of a hunter and fisherman. He told me at one time that thirteen years elapsed without a person other than his family sheltering under his rooftree. He raised a large family of sons, all of whom took to the woods naturally, and they have made themselves the terror to the game and fish of that country. One of the boys threw back to some remote ancestor and is an accomplished fiddler, having even composed some strange, wild airs. To one of these he gave the title of "Hannah Gutting Fish."

At old man Hammond's house was always a store of the products of the wild: jerked venison, smoked bear meat, wild honey, and other things. In season he partook of all the richness of the wilderness. Not the least of these were the wild ramps, a member of the lily family, the most powerful antiscorbutic known. Except in the dead of winter fish could be had for breakfast by catching a mess of trout while the water was heating to make coffee. Williams River ran by his door. All that was needed if fish were desired was to bait a hook, fish the river for a few rods, and breakfast was in hand.

As a compensating provision, however, nature has provided that, while mountain trout are pronounced to be the greatest of all table delicacies, yet the food is so rich that it soon palls upon the appetite and is not desirable as a steady diet. The Hammonds, however, soon found that certain tenderfeet who lived just beyond the fringe of woods would be

willing to trade a pound of rancid western bacon for a pound of mountain trout. This perhaps seemed queer to them but it was nevertheless a fact, and being so, they took advantage of it and after that the trout lived hard. Those slimed disgusting things called trout were eaten with relish by the people of the low lands and in return they would trade, pound for pound, rich, fat, salty bacon. The sportsmen of the state have just succeeded, however, in having a law passed making it unlawful to sell game or fish and the effect upon the Hammonds is watched with considerable interest. Personally we hope to see them turn their faces towards the sinking sun and to keep a-going until they get to a place into which the sun sinks, so far away that they will never prey upon our woods and waters again.

In recent years there has been procured for this stream from the White Sulphur Springs fish hatchery something over a hundred thousand small fish, both rainbow and brook trout, and these fish have thrived and done well, restoring the river to something like its pristine glory. It has been maddening to think of the untutored Hammonds selling these fish pound for pound for western bacon. But we sometimes rise to the occasion and do what is necessary and so the law has been passed. The wise man will either wash his dishes or keep a dog.

In analyzing my subject in the true scientific way of a protector of the game and fish we find what the chemists call a "trace."

The height of his ambition seems to be to take his stand by the fishing water and kill noble game fishes until the slaughter covers him with blood and guts. He drinks strong water and his speech is coarse. Yet to the tender mercies of such as these is left the welfare of the game and fishes. Our legislatures are full of men who never saw a setting of fish eggs and who never set up a single night with a sick fish.

In West Virginia we have just passed through the travail of inaugurating a most stringent and effective protective measure. The laws of this state on the subject were very

meager and inadequate and there was a general demand among the sportsmen of the state for the enactment of such a law as would give relief by making the other man stop catching fish and killing game.

The common run of land owners are always hankering after the Roman law which gave the land owner the absolute title and right to the game and fish found upon his lands. Even if a wounded animal dragged itself upon the land of an old Roman farmer it was the landowner's just as much as though it was a domestic animal. The western barbarians inhabiting England, however, where might made right, placed the title of all wild animals in the king, and he maintained his standing army thereby. When the consumers rose up in their might and forced King John to hold a special session at Runnymede, they got out of him the greatest game and fish law the world has ever seen, called the Magna Charta and Forestry Laws.

There were a few things in the bill about the lives and liberties of his subjects but in those days not so much was thought about these. The great victory was the concessions concerning the game and fish and especially the fishing in the rivers of England. The right to take certain amounts of the food fishes from the rivers was the thing that the barons of that day prized above all others granted to them. But the king kept all the rights in the game and fish not expressly conceded to the people. That is the law of this land. The state holds full title to all the game and fish and has the right to prescribe the conditions under which they may be taken.

More than anything else, I think, the trading of a pound of brook trout for a pound of bacon caused the people to murmur and get ready for another Runnymede. The Governor, who always had a remarkable ear for a groundswell, appointed a commission of killers to draft a protective law for the protection of the game and fish. On this commission was one member who at one time had been a killer but who had suffered a change of heart to the extent at least of being able to enjoy outdoor life in the woods without wanting to

kill all the wild life that was to be found there. The rest of the commissioners turned over to this comparatively kind and humane man the task of drafting the bill, while they went home to overhaul their fishing tackle and guns. While they were thus engaged, oiling up their deadly firearms and whetting their fish hooks, the man in charge went subtly to work and drafted a law which has about put an end to the hunting and fishing in the state, and which will cause the sportsmen to trade their rifles for cameras, and their fishing tackle for sketch books.

A law has been enacted prohibiting the sale of game and fish; no man may hunt and fish on the lands of another without a written permit; no hotel may serve game or fish to its guests; bachelor deer only may be killed; subjects of foreign potentates and powers are barred from their Sunday avocation; all persons must take out a hunter's license; game wardens are made fire wardens and can impress men to fight fires; railroads must not set the woods on fire and must keep the right of way clear; land owners may arrest any trespassers on their lands and bring them into court; the size and number of fish one may take is regulated, and the proud motto of the state, "Mountaineers are ever free," has a hollow and mocking sound. The valued right to fish on Sunday has been taken from many. On the whole the great majority of us sportsmen are like Othello—our occupation gone.

In conclusion I would ask this body of scientists to accord us a place in your scheme of life. We are not so black as we have been painted. So far as our influence and help goes, we are yours to command. We do not often intrude upon your deliberations and if we are often silent in recognizing the value of your great work, believe me, we do not fail to appreciate it. Go on with it, making two fishes grow where one grew before, and the nations of the earth will rise up and call you blessed.

Give fools their gold, and knaves their power,
Let fortune's bubbles rise and fall;
Who plants a tree, or trains a flower,
Or stocks a stream is more than all.

SOME DETAILS OF SALMON CULTURE

By W. O. Buck,
U. S. FISHERIES STATION, GRAND LAKE STREAM, MAINE.

The purpose of this paper is to raise questions for discussion rather than to answer them. It may not, however, be out of place by way of introduction to run over briefly the writer's recent experience in the culture of landlocked salmon, even though it should furnish a basis for criticism only.

At Grand Lake Stream wild brood fish are trapped and impounded as they approach the stream from about the middle of September until the end of their run two months later. None are touched until about ready to yield their eggs. Then all on hand are examined and distributed in retaining pens according to condition. The original enclosure is of large extent, good depth, and has an ample flow of water, so that the fish remain in it in apparent perfect condition. When the fish are ready, the eggs are taken and milted by the "dry method," carried to the hatchery and kept on trays till eyed, the dead eggs being picked out under water about every tenth day. When the eggs are eyed they are poured a few times from one pan to another to whiten the unfertilized, which are then picked out. The rest are returned to the trays and held as before until either shipped or nearly ready to hatch. Those retained are then distributed on coarse meshed trays to the troughs in which they are to be hatched and carried through the sac stage. The present season 12,000 were put into a trough about a foot wide and 10½ feet long, the water being 5 inches deep and flowing in at about 5 gallons per minute. The trough-stand is out of doors and tight covers are provided projecting over the edge of the trough so that light is almost wholly excluded.

A dam reaching about an inch above the surface is put into each trough near its head, forming a small pool into which falls the water from the inlet. This dam keeps the fry from getting under the inlet, where they might be injured by the force of the falling water, and also serves to distribute the flow across the width of the trough. A partition screen is put midway in the trough, giving two compartments each containing 6,000 fry.

The troughs remain unbrushed from the time the eggs are laid out to hatch until the sac is gone, dead eggs being picked out daily with tongs, and dead fry with a small fan, by which they can be lifted without touching the others. The fan is made of small wire bent near its middle to form a square about 1½ inches on a side and having threads tied across to form a net, the rest of the wire being twisted together to receive a handle.

As the water grows warm and slime appears the practice of "mudding" is begun. The earth employed is a fine sandy loam, which is introduced daily thereafter through the summer by holding a half-pint of the earth in a bowl-stainer under each inlet. The finer particles are washed through the strainer and carried by the current to all parts of the trough. The sand thus introduced keeps the bottom free from slime and is allowed to accumulate. When the sacs are absorbed the fry are siphoned out. Those to be liberated are carried in pails to the lake, and in the same pails or in cans, the water being frequently changed, they are conveyed by boat or canoe to suitable places along the shore, care being exercised to scatter them widely.

The troughs are now thoroughly cleaned, partition and headscreen removed, and 1,000 young fish are returned to each trough to be fed through the summer. The flow is increased to about 10 gallons per minute, and later to 15 gallons as the temperature rises.

Four feeds per day are offered, consisting of herring roe and beef liver ground together in a meat-chopper, the method being to mix the ground food with water to the consistency

of cream and throw a little into each trough, scattering it well and going at once to the next trough. When the entire series has been treated, the operation is repeated, food being offered three times at each feeding period in amounts varied according to judgment.

Dead fish and waste are removed with fan or scoop each day, care being used not to touch the fish when it can be avoided, and the sides of the trough are cleansed about every fourth day. The sand on the bottom is disturbed only as much as is necessary for removal of waste. When the troughs are cleaned the dams at the foot are lifted so that the slime and waste are drawn by the extra strong current thus created to the lower end of the trough and taken out. In brushing the foot screen, even outside, care is taken that no fish be lying against it, lest fins or tails be injured.

After feeding is begun and until the fish are large enough to cause alarm lest they jump out, the cover is left off the upper half of the trough through the day. This gives free access for feeding and offers the fish a choice of coming into the light or remaining in comparative darkness under the lower cover. They seem to enjoy the light and will lie there unless disturbed.

Now as to results. Of 2,000,000 eggs taken, 72 per cent eyed, and of these 98 per cent hatched. The fry lost 2 per cent and at this writing the fed fish are losing about 1 per cent in ten days. The above suggests the questions:

I. What is that essential condition met by fish spawning naturally, and by fish culturists when practically all eggs are fertilized, but which is missed when less than all are fertilized?

All who have handled eggs and fallen short of perfection in fertilization will hope with the writer that an answer to this question may be forthcoming. If we cannot now answer it, the question seems worthy of further study, since it is not apparent why there should be any failure of fertilization in the case of ripe eggs rightly handled.

II. What quantity of light should be admitted to eggs, fry,

and fed fish? The writer believes for eggs and fry the less the better, and that older fish should at least have a refuge from sunlight.

III. May fry or older fish be handled or even touched without danger? The writer suggests that the conditions which will admit of handling are exceptional, and that it is to be avoided as far as practicable. A fortunate instance of this exceptional condition is that of salmon at spawning time, when the skin is so toughened that the fish may be handled without injury. It may be mentioned in passing that this is not true of the togue (*Cristivomer namaycush*).

IV. Where and how shall fish be planted?

On this point the suggestion is offered that where no local objection exists a stream is the proper place, but that there and elsewhere, scattering is all too liable to be regarded as one of the minor details.

THE KING SALMON OF ALASKA

By John N. Cobb,
ASSISTANT AGENT AT THE SALMON FISHERIES OF ALASKA,
U. S. BUREAU OF FISHERIES.

The king salmon (*Oncorhynchus tschawytscha*) of Alaska, known as the chinook and quinnat elsewhere on the Pacific Coast, is one of the most interesting and valuable of the salmons found in Alaska.

It has been conclusively demonstrated that king salmon frequent the waters of Southeast Alaska throughout the year. This section contains an immense number of large and small islands, which are separated from each other and from the narrow strip of mainland separating Alaska from Canada, by large sounds, straits and bays of salt and brackish water, in which the fish find ample food. During the spring months large schools of herring frequent the shoal waters for the purpose of depositing their spawn, and it is then that the king salmon are found in the greatest abundance, as they are pursuing and devouring the herring. They also consume large numbers of the smelt and eulachon during the annual runs of these fishes to the rivers to spawn. Octopi and other miscellaneous animal food are also found in the stomachs of the salmon at times.

During the winter the kings are but rarely seen at the surface. Some are, however, taken every winter on halibut trawls set at times in 30 and 40 fathoms of water in Ernest and Frederick sounds and Chatham Strait, and these salmon usually have halibut, rock cod and cod in their stomachs. At this season but little animal life is found near the surface, hence the kings are compelled to go deep for their food. Indian fishermen on the Stikine River say that kings are found in the deep pools along the river during this season, and they get them by cutting holes in the ice and spearing

the fish. Kings are also said to be found in the river at the Hot Springs, about 40 miles from the mouth, where they remain until the ice melts in the rest of the river.

In the spawning season the king salmon ascend certain streams during the months of May, June and part of July. They are also found running as late as August and September in the headwaters of the Yukon and its tributaries, over 2,000 miles from its mouth. The principal streams frequented at this season are the Unuk, Stikine, Taku, Chilkat and Alsek rivers in Southeast Alaska; the Copper and Kenai rivers in Central Alaska, and the Ugashik, Ugaguk, Naknek, Kvichak, Nushagak, Togiak, Kuskokwim and Yukon rivers in Western Alaska. It is possible that they also enter certain of the streams debouching into the Arctic, but this has not yet been definitely established. A few are found along the Arctic Coast, however. It is the general belief in Alaska that this species enters only those streams which carry glacial waters.

Some of the Southeast Alaska fishermen claim that king salmon spawn at different periods of the year, and that they do not all die after once spawning. In proof of these beliefs they instance the numerous small kings found with well-developed spawn and the many large kings with immature spawn.

At Ideal Cove, just off the mouth of the Stikine river, in May, 1908, the fish cleaners found a 7-pound male king with milt. Several days before a female king of about the same size with fairly well developed roe had been handled, also a 20-pound king with roe of about one-fourth the size of that in other fish taken at the same time. A reliable Juneau fish dealer, who has been handling salmon for years, states that he has met with a number of cases of small and immature roe in large kings, also of large roe in kings weighing from 10 to 15 pounds. I myself have taken from a king salmon weighing about 25 pounds a single slender strip of roe, about 6 inches in length, which was composed of quite small and immature eggs. This was at a time when the great part of the run was of fish with well developed roe.

This variation in size of roe and fish might be accounted for if there were two runs of kings during the year, as in the Sacramento and Columbia rivers, but, so far as our knowledge extends, such is not the case in Alaska. In July of this year (1909), a period when the schools of spawning fish have reached those portions of the rivers above tidewater, king salmon were taken by means of trolling in various parts of Southeast Alaska, thus showing that all do not spawn the same year, even though they may be uniform in size.

While the fish are feeding they are caught solely by trolling, being so scattered that the use of nets is unprofitable. In trolling the white fishermen generally use either the Hendryx Seattle trout bait spoon No. 5 or the Hendryx Puget Sound No. 8. The former comes in nickle or brass and nickle and brass; the full nickle is preferred. The Siwash Hook No. 9/0, known as the Victoria hook in British Columbia, is in quite general use. As a rule but one hook is used, and this hangs from a ring just above the spoon, while the point of the hook comes a little below the bottom of the spoon. Occasionally double or treble hooks are used. Some fishermen use bait, and when this is done the herring, the bait almost universally employed, is so hooked through the body as, when placed in the water, to stretch out almost straight and face forward as in life. Generally the line is trolled near the surface, but sometimes a heavy sinker is attached and the line sunk some 30 to 50 feet below the surface.

When hooked the king makes a most gallant fight for life, sometimes a half hour being required to land one with an ordinary trolling line hauled in hand over fist. When a rod and reel is employed several hours are sometimes required to land a large specimen. The fishermen claim to be able to distinguish by its actions whether they have a red-meated or a white-meated fish on their hook. If a red-meated fish it will break water once and then sound, while a white-meated specimen will make its fight for life close to and at the surface, and will also fight much harder than its darker colored brother.

When the kings begin to school, preparatory to ascending the rivers to spawn, they are taken almost wholly by means of gill nets. They will rarely ever take a bait at this time.

The most peculiar characteristic of the Alaska king salmon, and a most unfortunate one for the fishermen and dealers, is that the flesh is not always of uniform color. In Southeast Alaska the flesh of the majority of the fish taken is red, but in about one-third it is white. Occasionally a specimen is taken with the flesh on one side of the body white and on the other red, the line of demarcation being very distinct. A few also are found with the white and red intermixed, giving a mottled appearance. In Cook Inlet, in Central Alaska, the run is composed wholly of red-meated fish, and in Bristol Bay, Bering Sea, the earliest runs are almost wholly red-meated, but white-meated fish appear in the later runs.

The fact that the majority of the fish are red-meated in Alaska shows that this is the natural color of the flesh of the king. This is further attested by the fact that southward all along the Pacific Coast the runs of this species are wholly, or in majority, red-fleshed fish. The Sacramento and Columbia river kings are virtually all red-meated, the white color becoming prominent first in Puget Sound waters.

As the commercial value of the king salmon is largely dependent upon the degree of redness in the color of its flesh, it is easily to be seen that an excessive proportion of white-meated fish in the catch would seriously affect the price. In disposing of his catch in Alaska the fisherman insists that the dealer shall take the white-meated kings along with the others, which is done at a considerably lower price—about one-third that paid for red-meated fish. The greater part of these are shipped fresh and disposed of for what they will bring in the Puget Sound markets.

It has been noticed that the largest and fattest fish are usually white-meated. One taken in May of this year, in the neighborhood of Klawak, on the west coast of Prince of Wales Island, weighed, without the head, 101 pounds, which

is the largest king salmon reported from Alaska. Some people in Alaska claim that the white-meated fish when cooked have a better flavor than those of a red color. The exterior appearance is exactly the same, the only way to determine whether the fish has red or white flesh being by cutting it.

The reason for this remarkable variation in color of flesh is still unknown. It has been ascribed to the food of the fish, but this would hardly seem to be borne out by the few facts so far gathered in Southeast Alaska, where the variation is most noticeable. I have personally opened a number of stomachs of king salmon, and have also watched the cutters at the fishing establishments doing the same, and found the same class of food in them without regard to the color of the flesh.

Herring is the principal food of both varieties and it does not seem reasonable that this food could have such opposite effects in two fishes traveling practically side by side. The color could not be caused by food at present unknown to us, unless this food was partaken of during the winter months, when, owing to the lack of animal life at the surface, due to the coldness of the climate, the fish seek the deeper waters and are only occasionaly taken on trawls set for halibut.

Several housewives have stated to me that in a few instances when cooking red-meated kings they observed the flesh to turn white during the operation. Experiments in the cooking of this species might possibly disclose the reason for the variation in color.

DISCUSSION.

Dr. Barton W. Evermann: I think attention should be called to two or three conclusions which the writer seems to have reached.

In the first place the question of white or red meat is not one that is limited to Alaska. White-meated salmon and red-meated salmon are found all along the coast, at least as far south as the Columbia River; but the percentage of white meated salmon in Alaska is usually regarded as much greater than in the Columbia River. The theory of the Indians that they can tell whether the fish is red-meated or white-meated by the way it bites or pulls or whether it sounds, is an interesting one. The red-meated one jumps, I believe, and then sounds; the white-meated one does not jump at all. It frequently happens that a fish is half and half—about half is white-meated and about half is red-meated—now what would one of this kind do when hooked? And of course there are white-meated ones in the Yukon and Bristol Bay, as well as farther down the coast.

It has often been stated by various persons that they cannot believe that salmon die after spawning but once, because they are not all of the same size. That doubt or that conclusion would be based upon the fallacious belief that all salmon of the same age must necessarily be of the same size, and upon the additional fallacious belief that all salmon necessarily spawn at the same age. Mr. Cobb's theory apparently is that a fish which is very large has spawned more than once, and the smaller one perhaps only once. You might just as well reach the conclusion that a man who weighed 300 pounds has been married three times and a man who weighed 100 pounds had been married only once or not at all. (Laughter.) There is no more reason in the one case than in the other. There is no reason why all king salmon that are three years old should tip the beam at exactly the same notch. It is quite certain that they do not. In fact everything that is said regarding the nature of salmon of different sizes has been known along the Columbia River, and to everybody else almost, for many years.

THE RAINBOW TROUT IN MICHIGAN

By Seymour Bower,
superintendent michigan fish commission,
detroit, mich.

The few points I desire to present in regard to rainbow trout cannot be considered as rising to the dignity of a formal paper, but are offered for what they are worth and mainly with a view to calling out discussion as to the relative value and comparative merits of one of the gamest of American fishes. In speaking of rainbow trout I wish to explain that I also include steelhead trout, which for practical purposes may be considered one and the same species. Indeed, so high an authority as Dr. David Starr Jordan told me within the past thirty days that he now considers the rainbow and steelhead as one species, although he was formerly in doubt and at one time regarded them as separate.

The introduction of rainbow trout into Michigan streams dates back to the early eighties, in fact, a small planting of rainbows was made in the Ausable River in the middle seventies by the late N. W. Clark, of Clarkston, and the late Daniel Fitzhugh, of Bay City. Prior to that time the rainbow was a total stranger to Michigan waters and was entirely unknown throughout the east and middle west. For nearly twenty years after the first planting by the Michigan Fish Commission, the distribution was exceedingly limited in numbers and was confined to a few streams. The total number planted by the Michigan Fish Commission from 1880 to 1889, inclusive, was only 67,000 fry. During the next decade the total of the plants was 437,000, or an average of less than 50,000 per year. Beginning with the year 1900, however, the distribution of rainbows by the Michigan Board was made on a somewhat more generous scale. From 1900 to 1908, inclusive, a total of about 5,500,000 fry and

nearly 100,000 fingerlings were deposited, or an average of over 600,000 per year. During the present year our total output will approximate two million fry and a quarter of a million fingerlings. From present indications our output of 1910 will total between three and four million. Thus it will be seen that the Board of Fish Commissioners of Michigan believe that the planting of rainbows is a valuable contribution to the fishery resources of the State.

Since the planting of these fish in Michigan was taken up by our State Board, distributions to some of the same waters have also been made by the United States Fish Commission and Bureau of Fisheries, but in much smaller numbers. It if safe to say that less than 10,000,000 rainbow trout all told have been distributed throughout Michigan during the thirty years in which the work has been carried on, or an average of less than 350,000 per year. Nearly ten times as many brook trout have been planted in Michigan during the same period by the State Board alone, yet in proportion to the number distributed the production of adult rainbows is much greater than of brook trout. Indeed the planting of rainbows in this State has been attended with more generous results and perhaps has proved more successful in every way than any fish cultural work attempted by our Board. Rainbows weighing five pounds and upwards now inhabit many of our streams by the hundreds. In the St. Mary's, Pere Marquette, Pentwater, Boardman, Pine, Muskegon, and other rivers, 8, 10 and 12 pounders are not uncommon and specimens ranging from 14 to 16 pounds have been taken. Twenty pounders have also been reported as having been caught with nets, but it is difficult to verify these reports because net fishing for rainbows is illegal. There is, however, scarcely a doubt that rainbows of that size now inhabit some of the above waters. The Ausable River, which with its numerous spring-fed tributaries constitutes one of the greatest brook trout systems in this country, if not in the world, is also one of the best rainbow trout streams in Michigan in the middle and lower reaches of the main river.

Here as elsewhere the larger rainbows, or those of a spawning size, do not as a rule run into or invade brook trout territory proper, except during the spawning season, after which they drop down stream to their old haunts where food and temperature conditions are more congenial. In some cases large rainbows prefer to inhabit deep and moderately cool lakes, ascending tributary streams only during the spawning season.

There is scarcely a doubt that the rainbow in the course of time will rank as a commercial fish of considerable importance in Lakes Michigan, Superior and Huron, and in these waters they should not be regarded or treated as a game fish but rather as a commercial fish, subject only to the same restrictions as are applied to the other commercial varieties. Large rainbow trout lose their game qualities to a great extent anyway after inhabiting lakes for a time.

Regarding the food qualities of rainbows as compared with brook trout, it must be acknowledged that they are usually softer and less palatable than the latter when young or immature, that is to say, the flesh of a 7 or 8-inch rainbow is not so firm and sweet and rich as that of a brook trout of the same size. One reason is that an 8-inch rainbow is not nearly so far advanced toward maturity as an 8-inch brook trout. Rainbow trout do not spawn in Michigan waters until they are 3 and most of them until they are 4 years old, whereas brook trout spawn when about 20 to 22 months old. It is, however, the almost unanimous opinion of anglers and epicures that rainbows of two pounds and upwards are not in the least inferior to brook trout of a corresponding size or age. For this reason, the legal limit for rainbow trout should be considerably greater than for brook trout. It should not be less than 10 inches.

Although the rainbow trout has very many firm and even enthusiastic friends, and the list is constantly growing, yet there has been and still is considerable opposition to its further introduction into our streams. This opposition is not because it is not recognized as a high grade food and

game fish but because it is considered inferior to brook trout and is driving the latter out. A careful investigation of the situation, however, will, I believe, show to a very great extent that this claim has little or no foundation in fact. It is true that a number of our larger streams, once suitable for brook trout from sources to mouth, are now occupied by rainbow trout in the middle and lower waters, almost to the exclusion of brook trout. The natural supposition is that the latter have been driven out, when as a matter of fact such waters would now be deserted by the brook trout if the rainbows had never been introduced. The clearing up of heavily timbered areas or sections has so changed the character and temperature of many streams that the brook trout have retreated nearer and nearer the headwaters. I do not for one moment favor the planting of rainbow trout into any stream or stream system that is suitable for brook trout from sources to mouth, though the introduction of rainbows into such waters will not displace the brook trout to anything like the extent that is generally supposed. The truth is that while the young rainbows may mingle with the brook trout until they are one or two years old, they are certain sooner or later to drop down stream, seeking warmer and more congenial waters. Another good reason why rainbow fry should not be planted in cold brook trout waters is that they are to a great extent preyed upon and destroyed by the brook trout. The hatching season of the rainbow occurs in May and June, and if the young fish are turned out as fry they are just about the right size to serve as food for young brook trout whose hatching season is about six months earlier, as well as for the yearlings. Brook trout are more carnivorous, more destructive of their own kind and of fish life generally than are rainbows. In proportion to their size they have a much larger mouth, more teeth, are more ravenous and feed more during the months of May and June than at any time of the year. Although rainbows will spawn to some extent on the same grounds as brook trout, I believe that the fry should be planted farther downstream. But wherever planted, the separation of these

two species will take care of itself in a great measure, because each is at its best under a different set of conditions, and will seek those conditions.

The game qualities of rainbows are so well understood by anglers generally that little need be said on this point. Of course I do not refer to the old and superannuated fellows who are passing the evening of their life in the quiet waters of lakes, but to the lusty and vigorous young stock of the pools and riffles and rapid waters of our larger rivers. Doubtless many of the members of this society have read the following from Jordan and Evermann's "American Food and Game Fishes." If any of those present have read it, I am sure you will be pleased to hear it again, and if any of you have not, you have missed something good:

In beauty of color, gracefulness of form and movement, sprightliness when in the water, reckless dash with which it springs from the water to meet the descending fly ere it strikes the surface, and the mad and repeated leaps from the water when hooked, the rainbow trout must ever hold a very high rank. The gamest fish we have ever seen was a 16-inch rainbow trout taken on a fly in a small spring branch tributary of Williamson River in Southern Oregon. It was in a broad and deep pool of exceedingly clear water. As the angler from behind a clump of bushes made the cast, the trout bounded from the water and met the fly in the air a foot or more above the surface; missing it he dropped upon the water only to turn about and strike viciously a second time at the fly as it touched the surface; though he again missed the fly, the hook caught him in the lower jaw from the outside, and then began a fight which would delight the heart of any angler. His first effort was to reach the bottom of the pool, then, doubling upon the line, he made three jumps from the water in quick succession, clearing the surface in each instance from one to four feet, and every time doing his utmost to free himself from the hook by shaking his head as vigorously as a dog shakes a rat. Then he would dash wildly about in the large pool, now trying the opposite direction, and often striving to hide under one or the other of the banks. It was easy to handle the fish when the dash was made up or down stream or for the opposite side, but when he turned about and made a rush for the protection of the overhanging bank upon which the angler stood, it was not easy to keep the line taut. Movements such as these were frequently repeated and two more leaps were made. But finally he was worn out after as honest a fight as trout ever made.

The rainbow takes the fly so readily that there is no reason for resorting to grasshoppers, salmon-eggs, or other bait. It is a fish whose gameness will satisfy the most exacting of expert anglers and whose readiness to take any proper lure will please the most impatient of inexperienced amateurs.

DISCUSSION.

Dr. Barton W. Evermann: The rainbow still stands as the banner game fish of those that I have ever caught. The Society may be interested in hearing a word in regard to an investigation that the Bureau is carrying on now with reference to the relationship of the rainbow, steelhead and cut-throat trouts of the Pacific Coast. Dr. Gilbert of Stanford University began more than a year ago to study this question seriously, and is still continuing it. Among other things he examined the stock of fish at all of the trout hatcheries in California, Washington and Oregon. He collected from various undefiled streams (so as to get if possible native fish) fish that had not been contaminated through fish cultural operations. He then took and fertilized eggs from what were regarded as undoubted rainbows; then the eggs of undoubted steelheads were likewise taken and fertilized. He is keeping the progeny separate and under observation until they reach a size that will enable him to know whether any differences develop. The experiments are being carried on chiefly at the Brookdale hatchery near Santa Cruz, California. The California Fish Commission is heartily co-operating with the Bureau of Fisheries in this work. Dr. Gilbert feels that when he gets through with the investigation he will know positively the taxonomic relationships of the steelhead and rainbow for the regions in which he experiments. He has already gone far enough to justify him in saying that the conclusions which will be reached from a study of the rainbow and the steelhead of the Santa Cruz region, south of San Francisco, will not necessarily hold with regard to the rainbow or steelhead in Washington or Oregon, so that there are several local problems each of which must be solved on the ground.

It is regretted, I think by all of us, that the stocks of rainbows and steelheads and hybrid rainbows and steelheads in the hatcheries on the west coast are not safe for experimental purposes. You cannot be sure of the genealogy or ancestry of any of them; so wild stock has to be obtained in every case. But even considering the great care taken, in many cases doubts will arise. However, I think Dr. Gilbert is eliminating all individuals where there is any doubt as to the true stock; he is experimenting only with what he believes to be undoubted rainbows on the one hand and undoubted steelheads on the other. He has written a number of letters to the Bureau from time to time detailing his experiments and expressing in a tentative way some of his conclusions, but closing in every case by saying that all these conclusions are merely tentative.

President: I know I ought to keep my seat, but I cannot help breaking in. I have studied the rainbow trout to some extent and am very much interested in them. I suggest that before Dr. Gilbert finishes his studies he will necessarily have to go to Alaska and study the rainbow and steelhead there, because if I know anything about fish, I am sure that they do not represent the same species. Some years ago Dr. Jordan,

after having declared that the rainbow and steelhead trout were identical, found what is now recognized as a steelhead and he set it up as a distinct species. Dr. Evermann I think even now is inclined to believe that this particular species must be set off from the common rainbow as well as from the steelhead.

I am too much engaged in trying to produce and distribute fish to have time to follow the details of the technical study of fishes, but we get eggs from a race of rainbows that cannot be distinguished by external marks from the original rainbow brought from the McCloud River in California. We take eggs as early as December and at some of our stations as late as April, or pretty close to the first of May.

Now, are there several races of the *irideus?* I suppose so—some early spawners and others spawning later. We certainly have them, and I think you will find by looking over the records of the early work of the New York Commission that the difference was noted as early as 1868 or 1869, long before eastern fish culturists had meddled with the relationships of the western fauna. It is an interesting point. I think I can tell the difference between a young rainbow and a young steelhead every time. I may be wrong, but I think the steelhead is always slimmer, that he has more white margin on his anal fin, and perhaps a white caudal tip which I do not find on the rainbow.

I am very glad that Dr. Gilbert is going into this subject with the wild fish, for the question will never be settled until a conclusion is reached on virgin ground. As it stands now we certainly have two races of rainbow trout, and neither one of them is the same as the steelhead, at least not what I call the steelhead.

Mr. John W. Titcomb: Mr. Bower's paper has opened my eyes somewhat about the rainbows in Michigan. When I was engaged in fish culture in Vermont I supposed from what I had read that the introduction of the steelhead and rainbow into the waters which by deforestation had become warmer in the summer, would be a good plan. But there we encountered the obstacle which usually comes with the warmer water of summer, namely, the extremely cold water of winter. I discovered the rainbow was sensitive to anchor ice, which not only would cause large mortality in hatching but also among the adult fish when little needles of ice were flowing through the water. The rainbows which have been introduced in New England and New York in large numbers for a good many years do not seem to have produced very favorable results. There are today but few streams which have been successfully stocked, and in few of those which have been stocked do the adult fish hold their own by natural reproduction.

Now, as to the identity of the steelhead and rainbow, I think you all understand that the rainbow of New Zealand is the steelhead of California. It has been thoroughly identified from the source of supply, and is what might be called a sea-run rainbow. I could not see the difference between the steelhead hatched in Vermont and the rainbow hatched in Vermont. If they got mixed I was unable to sort them, although I always imagined the steelhead was a little more gamy than the rainbow.

I remember calling on Commissioner Brice in Washington once, and saying to him that I could not see any difference between the two fish; that I thought they must be very closely related; and he said: "Well, I have given out word that the rainbow and steelhead are two distinct species, and that settles it!" (Laughter.)

Now, as to the spawning time to which you have referred: I find so far as my observations go, and what I learn from the different superintendents, that it is regulated very largely by water temperature. As you know, at Wytheville, Virginia, we have handled rainbows for a great many years, and the first hatch from the domesticated stock there was in the spring. As time went on the spawning season gradually turned backward until now we take eggs in November from descendants of the same stock of rainbows. In Vermont rainbows hatched and reared in very cold water where anchor ice flowed part of the time, did not spawn, as I remember it, until April or May. In Colorado where the rainbow is an introduced species it spawns just before the native trout in the same waters; in others at about the same time; but on the average in April and May, perhaps a month earlier than the native trout.

PRESIDENT: By native trout you mean the black-spotted?

MR. TITCOMB: Yes. We are taking black-spotted trout eggs now. I do not see how we can connect the spawning time with the species, for it will be found that fish of the same stock will spawn in one water even three months earlier than in another.

PRESIDENT: In Lake Cayuga last fall we took rainbow eggs in December, and again in the same lake as late as April. We also took a steelhead in Keuka Lake last fall. If it was not a steelhead I do not know what it was, for certainly it was not a rainbow.

MR. TITCOMB: My observations agree with those of Mr. Bower, that rainbow trout seek the lower waters. In Vermont they take the waters usually below those where brook trout are found, except an occasional straggler or a very large fish that goes farther down into the deeper pools. This water is rather warm for brook trout. In Colorado the native black-spotted trout occupies the head waters, the eastern brook trout the middle course, while rainbows are principally found in the lower and larger portions of a stream. There the rainbow is the most popular of the three species, I think, the eastern brook trout ranks second and the native third.

You may be interested in knowing that the Denver & Rio Grande passenger agent has a standing offer to any angler who lands with fly and rod and reel a rainbow trout weighing ten pounds or more. His reward is a $20 gold piece for each fish, which he usually has to pay about twice a year. The largest rainbows are generally taken from the Gunnison River.

MR. W. E. MEEHAN: The matter raises a query as to what we have at Bellefonte. Some four or five years ago we received from the United States Bureau of Fisheries station at Wytheville, Virginia, what was stated to be a consignment of rainbow trout. They were fingerlings and as they grew up, apparently two species developed. They were so dif-

ferent that any person standing on the edge of a pond could distinguish them. In one case the fish were much darker on the head and back, with a square tail—just as square as the brook trout—and in the other case the fish were much lighter, and with a decidedly forked tail, with other marks such as you have mentioned as belonging to the steelhead. The former were supposed to be steelheads and the latter rainbows. Both fish spawn at the same time, from the latter part of November to about the first of January, the water temperature being about 54 degrees F. in the ponds.

As regards the spawning period of the rainbow trout, I have this experience to relate. Early in the 70's there was received from the United States Commission a shipment of rainbow trout eggs, presumably from the west. They were hatched and appeared to be all alike. They were divided into two lots, one being sent to the Allentown station and the other to the Corry station. The water at the Allentown station was 52 degrees F. and at Corry 48 degrees F. The Corry fish when they reached maturity spawned in April, towards May. The fish from the same lot of eggs spawned at Allentown about the first of November.

Mr. Titcomb: What is your experience with the rainbow in Pennsylvania waters? We have sent carloads of rainbow trout there, in response to the great demand for them, and then all of a sudden the anglers said they did not want rainbows.

Mr. Meehan: I have made inquiries everywhere but I cannot find a single stream in Pennsylvania where the rainbow or steelhead seems to thrive naturally, or at least to any great extent. There were one or two places where it appeared as though they were spawning naturally in a stream, but investigation showed that people who were getting rainbow trout for certain other streams, instead of carrying them to those streams, were planting them in the stream in which we were finding evidently three-year-old rainbows, two-year-old rainbows, yearling rainbows and fingerlings. I do not know of a stream in Pennsylvania where rainbows seem to be spawning naturally.

At the Allentown station we also found a very large percentage of unfertile fish every year. Today at the Bellefonte station at least 50 per cent. of the males and females are barren. At the Corry hatchery the percentage of fertile males and females is better, but even there many of the fish are unfertile. There has been such a large percentage of unfertile rainbows at the Wayne station that their propagation has been discontinued at that place.

Going back to the fish at the Bellefonte station, the square-tailed fish that we have supposed to be steelheads, though much the same as the other fish which I presumed to be rainbows, the question is, what are they if not steelheads?

I have a mounted specimen of a fish caught in an Erie County stream, said to be a steelhead trout, that weighs ten pounds. The fish had a square tail and other alleged marks of a steelhead. There was also another specimen of the same species taken from Lake Giles in Pike County, but it was destroyed by fire last year.

Mr. Frank N. Clark: Some of the members seem to consider it quite remarkable that rainbows should spawn in December and also in April. Why is it any more so with rainbow trout than with brook trout? There is even wider range in the case of the latter, for they spawn from September to February. We have a record at Northville of taking brook trout eggs from the same pond in October and February. Then what is there remarkable about the spawning season of the rainbow? We do not know but that it may be the same in their native waters. I do not think anyone will raise the question but what it might occur there; and certainly in transferring them here to new waters, we should not consider it unusual when the same thing occurs with our native brook trout. It is a matter of record that at Northville years ago I personally took brook trout eggs in February. I saw eggs taken from the same pond again in October.

Mr. Meehan: That is all right, but I do not think it is a parallel case. It is true that at some of our hatcheries brook trout begin spawning the last week in September, as at Corry, and generally they have finished by the first of December. The spawning is continuous but if we transfer the fish to another station it occurs the first or second week in October, according to the temperature of the water. If we transfer rainbows from one station to another the spawning season is either mainly in the fall or spring.

Mr. Seymour Bower: In regard to the rainbow and steelhead being one species, I would say that recently I had the honor of dining with Dr. Jordan in Detroit, when he stated that he had now made up his mind that they were one and the same species. He said that he had seen perfect young rainbows hatched from what were said to be steelhead trout, and perfect young steelheads from what were claimed to be rainbow trout. Now, while he did not state that these results were what made him think they were one and the same species, I inferred that this had a great deal of weight with him. He illustrated his position by a little incident. Those of you who have met Dr. Jordan know that he always has a fund of dry humor on tap for every occasion. A few years ago he had a friendly argument or controversy with a certain gentleman and said to him: "What is your authority?" "Why," was the reply, "Appleton's Encyclopedia, and I consider that very good authority." "Well," said the doctor, "I wrote that article myself, and I have changed my mind since." (Laughter.)

President: The rainbow trout in New York is, I think, coming more into favor than formerly. The demand for them is greater now than it was five years ago. We find that it does best in lakes from which it can enter tributary streams suitable for spawning purposes. For instance, Keuka Lake is a great rainbow lake at present, and from there they run up to Pleasant Valley stream which flows through our hatchery grounds. We take them in large numbers at the mouth of the stream, usually in March or April, and sometimes we take good eggs in December, apparently from the same kind of fish.

There are a great many lakes in New York which are suitable for

rainbow trout, and they cannot get away except to run up the tributary streams for spawning, which they do. We are told also that rainbows stay in some streams from which they could escape, but instead they remain and multiply and furnish good fishing. For example, rainbow trout were introduced in Great River, Long Island, by the Southside Sportsmen's Club about as early as they were anywhere in the State of New York. The club tired of them and concluded to let them go to sea. They went, but kept coming back to the river during spawning season, even trying to spawn in the waters of the club, and now the members would not part with the rainbows for anything, for they have as fine rainbow trout fishing as could be desired.

Mr. Titcomb: Why should you choose rainbows in a certain lake in preference to the native trout? Is there something about the lake which makes it better fitted for the rainbow than for the native trout?

President: Keuka Lake is a great body of water for lake trout. It is not suitable for brook trout so far as I know.

Mr. Titcomb: You would not introduce rainbows in a lake where brook trout thrive?

President: I don't know. It has been done very successfully in some waters, in Adirondack lakes, for instance. Mr. Woodruff also has them in his private lake and he is very fond of them. He continues to introduce them along with the brook trout, raising them both in his hatchery.

Dr. Evermann: It seems to me that there is some danger in reaching or drawing any positive conclusions from an observation on domestic rainbows and steelheads. I presume it is true that the domesticated rainbows in the various fish hatcheries of the country, or that have been planted in various streams in the east, have come from several sources; some are the descendants of fish that first came from the San Francisco region, the home of the original rainbow, while others are from up the Sacramento. The latter may have been either the Shasta or the Stonei species or sub-species. So it is quite probable that the domesticated rainbows of the country have come from at least three different sources, and are the descendants of at least three different species or sub-species. Now, the same is probably true of the steelheads. Steelhead eggs have been brought from the Columbia River and from Baker Lake in Washington, and perhaps other places. Whether or not it is the same steelhead throughout all of the west coast is still a question.

I quite agree with Dr. Bean that if you should look at the rainbows of Alaska and the steelheads of Alaska and had your eyes half open, you would be loath to admit that they were one and the same species; so that it goes back to the statement made a few moments ago regarding the line along which Dr. Gilbert is working. He does not propose to base his conclusion, or his only conclusion, upon an examination and comparison of the rainbows and steelheads of California in the Santa Cruz region, but will consider those of the Sacramento and farther up the coast. I think he is in the Puget Sound region now, and will eventually go to Alaska, which is one of the best fields for his work because there the strains are still pure. Fish culture has not come in and upset things

as it almost always does. It mixes things inextricably, so that in many regions problems of geographic distribution will remain forever unsolved. For illustration, consider the Panama Canal. If a careful biological survey of the waters of the two coasts and of the fresh waters of the isthmus is not made before the canal is completed and water runs through, many important problems which ought to be solved will forever remain unsolved.

Mr. Titcomb: It is true that we get our rainbows from two or three sources in California, and our steelheads from California, Oregon, Washington and the Puget Sound region. Of course they have become more or less mixed. Some have gone to Colorado waters, where eggs have since been taken and shipped east. The stock at the Wytheville station was obtained from different sources, but a part of it came from Colorado.

While we are on the subject of acclimatized species, I want to announce that anglers are having great sport at Sunapee Lake, New Hampshire, with the chinook salmon which has been introduced there from the Pacific coast along with the silver salmon. This year I received a letter from Mr. W. M. Kiel, of the Tuxedo hatchery in New York, saying that many chinook salmon weighing from four to five pounds and up to eight pounds are being caught. It is rather difficult to get hold of specimens because people catch and eat them without letting us know about it until afterwards. We are anxious to learn whether this Pacific coast fish will adapt itself to our New England lakes and breed there. Certainly it is furnishing great sport, and the New Hampshire Fish Commission is very enthusiastic over it.

President: What species did you say?

Mr. Titcomb: Both the silver and the chinook salmon, but only the chinook has so far been taken and officially identified. I think the silver salmon may also be found, as we planted more silvers than chinooks.

President: Do you recall the experiments of the Trocadero Aquarium in Paris?

Mr. Titcomb: Yes. Chinook salmon actually breed there.

President: I saw them.

Mr. Titcomb: Yes; and I saw their progeny.

Mr. Meehan: Mr. Titcomb's reference to the silver and chinook salmon reminds me of our experiment with silver salmon. Two years ago we received 100,000 eggs from the Bureau of Fisheries and sent them to the Wayne hatchery. I retained 10,000 fry and endeavored to rear them. The rest have been planted in certain streams in Wayne County tributary to the Lackawaxen and Delaware Rivers. Several small specimens of silver salmon were caught by fly fishing before the close of the season. The fish were four or five inches long and were brought to the hatchery for identification. Meanwhile the 10,000 that we retained grew rapidly, took food and remained perfectly healthy. They are now about a year and a half old and will run from six to nine inches in length. They rise very freely to the flies that skim the water and take food eagerly and show every sign of being a fish that will thrive in confinement in fresh

water. We may have to put fences around the pond to keep them from leaping out. They will jump two or three feet if anything is thrown to them, taking food as eagerly as brook trout. It looks as though the silver salmon is a fish that will thrive in our lakes. We feel very much encouraged in this work.

PRESIDENT: Going back to the origin of the rainbow trout in New York, I know from the records that the first eggs received at Caledonia came from J. B. Campbell, who was in the Shasta region. He was at one time an assistant of Mr. Livingston Stone on the McCloud River. That was the source of the first eggs hatched in New York; and others came from the same region a little later. Since that time New York has received rainbows from the United States Bureau of Fisheries. But the original stock of fish, it appeared to me, showed at least two subspecies. Mr. Frank N. Clark was on the McCloud River in my company in 1876, I think it was. At that time the rainbow trout were very plentiful in the river, and it seemed to me at least—I don't know whether Mr. Clark will remember it or not—that there were two kinds of rainbows in the McCloud River, the common stubby rainbow and a slimmer fish. I presume one was a subspecies and the other was a true *iridcus*.

MR. FRANK N. CLARK: It is true that in 1876 Dr. Bean and I made a trip to the Sacramento River with shad, then went on up to the McCloud River. In 1877 I went to the coast, Mr. Quinn accompanying me. In 1878 I made the same trip with shad again, and in going to San Francisco I arranged with the proprietor of a private hatchery for a supply of yearling rainbow trout, which we brought back to Northville. The first rainbow eggs ever taken in Michigan were from those fish, but they were not the first rainbow trout planted in Michigan. Previous to 1876 we had eggs; just where we got them I don't remember; but they produced the fry that Mr. Bower mentioned as being the first rainbows planted in the Au Sable River. The next lot of fry came from the yearlings that we brought across from the coast in 1878. We started with 125 yearlings from four to twelve inches long and reached Northville with some of the larger fish. We had a small take of eggs from those fish and the fry were planted in the Au Sable River by Mr. Fitzhugh.

PROPAGATION OF CRAPPIE AND CATFISH

By John L. Leary,
SUPERINTENDENT U. S. FISHERIES STATION,
SAN MARCOS, TEXAS.

It is not so much for what I know about the propagation of these fishes that I take up this subject, as it is to find out through the discussions of the Fisheries Society what others know. It seems as if everybody connected with fish culture in the United States has kept quiet about the propagation of these two valuable species. At the thirty-fifth annual meeting of this Society I asked some questions as to handling crappie—from my standpoint important questions. But they elicited only a blank, no one seeming prepared or caring to answer. I will now give you some of my experience during the past eleven years at the San Marcos, Texas, station.

During the fall of 1897, I collected 40 very fine crappie (*Pomoxis annularis*) from the Colorado River near Austin, and from Yorks Creek, about 18 miles south of San Marcos, and placed them in one of our best ponds. The waters of the Colorado and Yorks Creek are always slightly roily and often very muddy. After transferring these fish to San Marcos station, which was done with an unusual amount of care (as this fish I find hard to handle at all seasons in this climate) and after leaving them in the pond at the station for several days, I found every few days fish suffering from pop-eye, the eye enlarging until it seemed ready to burst from the head; then fungus set in and the fish died in a few hours.

This continued until I had lost nearly all my 40 fish. I had never handled crappie before, except to catch them in the creeks of eastern North Carolina, but these creeks were always roily and muddy after heavy rains. So I came to the

conclusion that the very clear water of San Marcos station was not suited to the fish. It must be that this clearness affected the eye. So I planted the remainder of the fish in my carp pond, which the carp kept muddy at all times. This proved the remedy, the fish beginning to improve and thrive at once, and when the pond was drawn in the winter I found 8 splendid specimens of crappie.

This led me during the next season to the following experiment. I wired off the narrow part of one of my ponds with one-inch galvanized chicken fencing, the inlet to this pond leading direct into the part wired off, and in this portion of the pond I placed 8 large carp, each weighing from 6 to 8 pounds. The effect was that the carp kept the pond at all times slightly muddy and the crappie placed in this pond had no pop-eye and produced quite a crop of young. I also noted that there were no young carp, showing that the crappie, both young and old, had fed on the young carp.

The results of this experiment led me to obtain from some of the nearby ranch owners the privilege of stocking their cattle tanks with crappie, allowing me to have a part of the young fish. These tanks are always slightly muddy and the result from these ponds or tanks, while not very large, has enabled San Marcos station to plant several thousand young crappie each year.

I also find it worse than useless to handle young crappie in this climate until the cool weather of winter sets in and hardens them. They will not stand handling and icing like other fish during the summer, the slightest change in temperature or water affecting them and producing that desperate disease fungus, to which this fish, more than any other I have ever handled, is liable. For roily or muddy ponds the crappie, or white perch, as it is known in Texas, is the very best fish, thriving as no other fish will, and it is of the very best of our fresh-water kinds.

Now for the catfish. I have tried to propagate both the spotted catfish (*Ictalurus punctatus*) and the blue channel catfish (*Ictalurus furcatus*) for the past four years and have

met with no success in the ponds at San Marcos station. We find both of these fish in the San Marcos and Blanco rivers, usually in the swift water over gravel or sand shoals, and I have an idea that they spawn in these rapid places, though it is said they seek holes in the banks of streams. So far, however, I have not located such spawning places; in fact I have not found their spawning grounds. Both fish are valuable for their food qualities. I have heard advanced a very foolish idea that eels must be kept in ponds with catfish if it is desired to have the latter spawn. This, however, is too absurd to carry any weight. I mention it merely to show the foolish notions of some fishermen.

I will be pleased to have through discussion all the information now in the hands of the Society as to the successful propagation of the above mentioned fish.

DISCUSSION.

Mr. John W. Titcomb: We have tried to propagate the channel cat and the Mississippi cat at half a dozen different pond stations without success, and from the observations we have made I think nobody definitely knows where they spawn. It is the general impression that the *Ictalurus punctatus* spawns on the little riffles around the rocks in perfectly clear, swift water. They are gamy and will not stand domestication in small ponds. We have a great many applications for these fish from people who want to stock small ponds. But it is useless to put them into ponds of small area, as they require ample range and do best, I think, in swift water.

Mr. W. E. Meehan: Several years ago we tried to propagate spotted catfish but with no success whatever. We tried them both in pond and stream without results in either case. With other species which we know as the white and yellow catfish, we have met with great success. To what extent this work is successful elsewhere, of course I do not know.

Any ordinary pond 100 feet square or larger will breed the fish; but we find that in order to succeed we must have heavy, hard clay banks, so that the fish when ready to spawn may dig a hole in the bank that will not cave in. The water should also be cloudy. When the little fish have arrived at the advanced fry stage, they leave the nest or hole, guarded by the large fish, and begin as we call it "rolling." The large fish circle round and round and move the fry over the pond in the form of a ball-like mass. When these balls begin to break up, the fry are gathered in by means of a net and put into a vacant pond, where they are fed and held for shipment as fingerlings. We find that the adults

do not require a great flow of water; but in order to keep them healthy they must be liberally fed, not only through the summer, fall and spring, but during the winter. The manner of feeding in the winter is to cut a hole through the ice and sink to within a foot of the bottom a wire basket filled with cut liver. The catfish feed therefrom very readily and emerge in the spring fine and plump and in good condition for spawning. I suppose we now have at our hatcheries from 700,000 to 800,000 young catfish ready for shipment.

In the propagation of calico bass we had better success where the water was a little cloudy. We experienced no particular difficulty, but the nests were built so deep that there was little opportunity to examine their character or the spawning habits of the fish. Some nests were found in eight feet of water and often only the appearance of the young fish around the shores led to the discovery of a nest.

Mr. Ward T. Bower: In regard to Mr. Meehan's remarks, it seems advisable to call attention to the fact that he has been discussing the yellow catfish—*Amciurus nebulosus*—which is quite different from the species referred to in Mr. Leary's paper.

Mr. Meehan: Entirely different.

Mr. Bower: So that the failure Mr. Leary has met with perhaps cannot be explained by Mr. Meehan's remarks.

Mr. Meehan: We absolutely failed with the spotted catfish, just as Mr. Leary did. In fact we gave it up three or four years ago, because we were unable to do anything with them.

Mr. W. J. O'Brien, Gretna, Nebraska: What do you call an ordinary sized fish pond.

Mr. Meehan: One of our successful ponds is about 150 feet square, another is 200x50 feet. I call them rather small ponds, but five or six of them furnish us about 700,000 or 800,000 fish.

President: I think some of you will recall the fact that many years ago the calico bass was introduced into France, and that an account of the spawning habits and nest building of the fish was published in a French fish cultural journal, "Pisciculture," I believe. The article appears in one of the bulletins or reports of the United States Fish Commission and corresponds very closely with the description given by Mr. Meehan as to the nest building and depth of water in which they spawned, also the comparative ease with which the young fish may be produced.

Mr. Charles W. Burnham: At the Tupelo, Mississippi, station we propagate crappie and bream in one pond about an acre and a half in size. They spawn in comparatively shallow water, about two feet deep. When this pond was drawn last fall we collected from it 9,600 crappie and over 10,000 bream. It is supplied principally with artesian well water and contains a heavy growth of pond plants. It also receives muddy surface drainage water in the spring, which seems to bear out the statement of the other gentlemen that crappie breed best where the water is somewhat roily. I also think that they require an abundance of vegetation,

Mr. S. F. Fullerton: The best evidence that crappie spawn in muddy water is found in the Mississippi River. For several years the government has collected bass and crappie at Winona and La Crosse, on the Mississippi. In the spring and up to June, after the crappie have spawned, the river is high and muddy. When it overflows the parent fish go into the sloughs to spawn, and as the water recedes we follow up and collect the small crappie and bass. In this way we saved 300,000 fingerlings last year, mostly between Winona and St. Paul, and the government collected, I understand, a much larger number. Besides stocking lakes in the state, we are also saving and putting the rough fish back into the Mississippi. They are taken in large numbers with the crappie. As the latter cannot be moved any distance in warm weather, they are not sorted out but are turned into the river with the rough fish. The bass can be shipped, but crappie will not stand shipment in a water temperature over 70 degrees F. We have tried various schemes but without success. Roily water is the place to hatch crappie; it cannot be done in clear water.

Mr. Titcomb: We treat calico bass and crappie almost indiscriminately in our distribution work. They seem to require the same conditions, that is, roily water during the spawning season. Mr. Catte, however, has a series of ponds fed by bottom springs of clear water, where he successfully propagates strawberry bass.

Mr. Eugene Catte, Langdon, Kansas: I hatch thousands of them in clear water.

Mr. Clark: Do you mean crappie or strawberry bass?

Mr. Catte: Strawberry bass.

Mr. Titcomb: Mr. Meehan says strawberry bass do best in cloudy water.

Mr. Meehan: That is true. Our strawberry bass did decidedly better where the water was a little roily.

Mr. O'Brien: Our experience has been quite different. We raise strawberry bass and crappie under exactly the same conditions. I believe roily water is essential for the crappie. Moss is not necessary, however, as we find thousands of crappie in natural streams like the Platte, Elkhorn and Missouri rivers, where there are practically no water plants.

Mr. Ward T. Bower: While I can give no authority for the statement, and perhaps it is a popular misconception, I have heard that a turbid condition of the water is necessary for crappie because of a peculiar construction of the eyes. Perhaps some one here has heard something along this line, and can throw further light on the subject. Possibly Dr. Evermann can tell us something about it.

Dr. Evermann: I know nothing about it.

President: Both crappie and calico bass have been introduced very extensively in the eastern part of New York, and have so multiplied that we are beginning to draw from stocked lakes for brood fish. For instance, when the New York Aquarium wanted to stock the park lakes of New York City and Brooklyn last spring, they asked the

Forest, Fish and Game Commission to furnish some crappie or calico bass—the names are used indiscriminately. What we have is really the deep-bodied fish, the true strawberry or calico bass. It is very abundant, especially in Kinderhook Lake, which is in Columbia County, and also in Nassau Lake, in Rensselaer County. One of our protectors went to Kinderhook Lake and easily seined about one thousand calicoes varying from a few inches to six inches in length. Then came the difficulty of getting them to New York. The water was warm and of course a great many were lost in transportation.

Another place where both calico bass and crappie are raised very successfully is in the vicinity of Covington, Kentucky, where Joe Schlosser, during the time of the Cincinnati exposition, had some artificial ponds from which he took ice in winter. These ponds were stocked with crappie, calico bass, pike perch, carp and bass, fishing privileges for which afforded a good source of revenue. The strawberry bass is evidently suitable for pond culture under almost any reasonable conditions. Kinderhook Lake is not muddy, but of course there are places where the fish can get the mud if they want it.

Mr. Meehan: It has deep water?

President: Yes.

Mr. Meehan: That answers the same purpose. Do you use ice in shipping them?

President: I have tried all methods, but cannot carry them in warm weather.

SOME ESSENTIALS IN POND CULTURE

By Felix A. Lauman,
PALESTINE, TEXAS.

Success in pond culture depends upon having a well defined system of procedure, together with surroundings approaching natural conditions as closely as possible. A station site should consist of from 20 to 30 acres of ground, so located as to allow the construction of ponds with sufficient fall to permit drawing off and also to dispose of all waste water. In addition there should be a flow which will fill the ponds and keep a constant current through their entire length. This prime factor is often overlooked. Too often hatcheries have to resort to pumping plants and other devices in order to keep the ponds filled, since the supply is only standing water without any current or overflow, the ponds thus really becoming tanks. Tank culture would be a more appropriate name for this kind of fish culture. An abundance of pure fresh water is as essential to the life and growth of the fish as pure fresh air is to the life and growth of man or plant.

There should be an investigation into the history of the lands, particularly as to past overflows. No greater calamity can befall a hatchery than an overflow, with the loss of brood stock and young fish, destruction or damage to ponds, buildings, and other property, thus ruining the prospect of success for years.

There should be a careful study of the chemical composition of soil and water. There is danger here not only of poisonous substances, but of others not conducive to success. With a hard clay soil and pure fresh spring water nearly all aquatic plants flourish, and these plants facilitate the production and growth of insects, so essential as food for the fish.

Having proper natural conditions the next requirement is suitable ponds, either natural or artificial, and of these there should be three distinct kinds of different sizes—spawning ponds, nursery ponds, and storage or shipping pools. As to the construction of the spawning ponds, in my observation the larger and deeper ponds yield the best results. A pond should be not less than one acre in extent, should have an oval or bowl shape, with a large area of shoal water, and an inlet at one end and an outlet at the other, in order to produce a current through the entire pond. The sloping bottom should gradually increase to a depth of from six to nine feet at the kettle and outlet. Nests, preferably of small gravel, should be placed over the bottoms of the ponds about 6 feet from the bank and about 20 feet apart, the nests being from 18 to 20 inches in diameter. These ponds should be well supplied with aquatic plants, which not only afford the fish a hiding place from their enemies but are essential to the presence of the animal life which constitutes the food of the young fish.

On account of the cannibalism among the young fish of some of the species, the larger ones mercilessly devouring the smaller and weaker, it becomes necessary to construct smaller ponds called nursery ponds into which the young fish are assorted as to size when taken from the spawning pond. In the building of these ponds great care should be taken to afford the young fish protection from their enemies and to have them well supplied with suitable vegetation, crustacea, small insects and other natural food. A pond 50 feet long by 25 feet wide, with a depth of 3 feet at the outlet, would be of good working size.

The storage or shipping pools are used for holding young fish when taken from the nursery ponds for shipment. They are small pools with concrete bottoms, a six inch brick wall for the sides, with a thick cement coating over bottom and sides, and are 6 feet wide by 12 feet long, the bottom gradually sloping to a depth of three feet at the outlet.

THE FUTURE OF THE CARP

By S. P. Bartlett,
U. S. Fisheries Station, Quincy, Ill.

From the experience of the past let us consider what are the possibilities of the future in regard to the culture of the carp. Few, if any, economic experiments looking to increasing the food supply of the people have shown such satisfactory results as has the introduction of the carp into the waters of the State of Illinois by the Bureau of Fisheries.

It is not necessary to recall the prejudice existing against carp in the early years of its introduction, how they were thrown away by the fishermen when taken in their nets and how they were pronounced worthless by nearly all who undertook their culture. The press throughout the country denounced them, and those responsible for their introduction. All this and more is familiar to most of you who have met with this Society year after year, and joined in the discussions brought out by papers which dealt with the subject. All of it was simply the result of a lack of knowledge of the value of the carp and ignorance of the possibilities connected with its culture.

It has taken a long time to demonstrate this value, but many States that were loud in their denunciation are now willing to accept the commercial advantages the carp represents, and openly advocate its culture, protection and care as an important addition to the supply of food fishes.

Everywhere, as generally as any of our indigenous fishes, we may find the carp, and it is not unusual to hear fishermen before legislative committees make the assertion that if they can be given a free rein to take carp they will gladly assist in the enforcement of any law for the protection of the game fishes. Without a knowledge of what the catch

of carp is doing for the commercial fishermen it would be impossible to form any idea of its real value from a commercial standard. Statistics will, I think, show nearly or quite 22,000,000 pounds of carp taken from the Illinois river and the lowlands adjacent to it during the season of 1908, and the majority of these fish were taken from the flat lakes, ponds and bays tributary to the Illinois river.

One might ask what progress has been made in the increase of the fish indigenous to our Illinois waters in the last twenty years that can not be traced indirectly to the carp. We have more bass and the reason is because we have more food for them by reason of the vast reproductivity of the carp.

In predicating the possibilities of the future of the carp, several phases must be considered. What has been the greatest food producer, and incidentally the money maker of the waters? Not the bass, nor the buffalo, once the great coarse fish supply of the Illinois river valley, but the carp. And why? First, because of its adaptability to all the waters of the State, with their varied conditions. Then because of its wonderful reproductive powers; its tenacity of life, which gives it a commercial value not possessed by any other fish; and finally, its real value as a table fish when properly taken and properly prepared.

We find carp everywhere and everywhere prospering. Other fish are killed out by adverse seasons but the same conditions do not fatally affect the carp. Every energy and all the ingenuity of man are exercised to take these fish, and if laws are lax all is to the detriment of the carp, yet they are continually on the increase. When sent to the markets they are always shipped "round," that is, not dressed, and I am told that they arrive at distant markets, if not alive, at least in such firm and perfect condition, when properly packed, as to meet the requirements of those great consumers of fish who insist that the blood must show when they are cut.

So much for the present status of the carp as a commercial asset of the people of the Illinois and Mississippi Valleys.

Now what of the future? The age of improvement, I believe, will affect the carp as it does all else and changes will occur that will greatly diminish the output. The Illinois river, for 250 miles on either side, presents an almost unbroken chain of lakes, usually flat, and many of them of great area, that are ideal homes for the carp, but increasingly each year, these bottom lands are being formed into drainage districts, and immense areas now producing hundreds of thousands of pounds of carp and other fish are being drained and the land cultivated. Such lakes inside of the levees as are not affected by drainage will be controlled by private corporations or individuals. The result will be that the river will have to furnish all the fish for the commercial fishermen. This condition is true of all bottom lands along both rivers, and it will be a live question soon as to where the fish are to come from.

So far, there has been but little effort made to cultivate carp for market and where such efforts have been made the results for various reasons now matter of history were failures. I believe the time is now ripe to utilize the hundreds of acres of water to be found throughout the State in the cultivation of this fish. With the knowledge we have of the life habits of the carp, and the care and feeding and protection necessary to its culture, the best results can be obtained. Systematic effort united with the same amount of care that would be used in any other enterprise would result in success, without doubt. Carp, like everything else, respond to care and attention, and if given as intelligent care as would be used in raising chickens may be expected to give the best of results. In this way better fish would be produced and better prices obtained.

The great trouble is and has been that carp have been taken from water at a high temperature, when the flesh would nat urally be soft and unfit for table use if a good flavor be expected; but careful investigation has showed that carp can be so handled that all the muddy or oily flavor can be removed.

Proper attention and feeding would add greatly to the

texture and flavor of the flesh, as well as to the rapidity of growth. I know of no other fish that responds so quickly to good food as does the carp, yet it is easily and cheaply cared for.

I have in mind a large number of places where carp culture could be undertaken with profitable results and if the supply is kept up to the demand, the time is not far distant when such places, now practically a waste, can be utilized so that the water can be made more productive than the land.

I can make no better argument as to the future possibilities of carp culture than to ask you to consider the following quotation from one of the best authorities on the question of fish food supply, Dr. Hugh M. Smith, Deputy U. S. Commissioner of Fisheries. He says:—

> It will suffice to say (1) that special investigation has shown the carp does exceedingly little harm to any other fish, as anyone would expect from its known habits and anatomical peculiarities; (2) that the injury done to the feeding grounds of wild fowl has been grossly exaggerated; on one hand, a scarcity of ducks may occur entirely independently of the presence of carp, and, on the other, a great abundance of carp may be coexistent with an undiminished growth of wild celery; and (3) that the carp is a food fish of very great importance, and to say anything to the contrary is to ignore facts.

The carp is here to stay. The markets take all they can get and ask for more. Thousands of acres of water can be utilized for successful culture, but in order to bring this about, intelligent application should be made of best known methods and care.

PROGRESS IN HATCHING STRIPED BASS

By S. G. Worth,
U. S. Bureau of Fisheries, Mammoth Spring, Arkansas.

Twenty-five years ago (Bulletin of the U. S. Fish Commission for 1884, p. 229) official view was expressed that the experts in fish culture would easily care for and develop with slight loss the eggs of the striped bass (*Roccus lineatus*), and that the real difficulty had been not so much in the hatching as in the finding of a place where the mature fish could be obtained with any certainty. Experience has demonstrated, however, that apologies have followed all attempts to hatch the eggs of striped bass, because of the disappointingly small product in fry. As I have, at last, overcome the difficulties in hatching this species so that any given lot of eggs may be hatched with entire satisfaction, I herewith present the facts which mark the progress in hatching to date, May, 1909.

Eggs of striped bass are easily hatched, as in pans of water, on wet trays, and in jars, but the rupturing of the yolk sacs subsequent to hatching has been a constant cause of heavy loss, the story of which is told in the floating pads or rafts of amber colored oil on the surface of tanks containing the fry. The sacs are almost as easily ruptured as the walls of a soap bubble.

The McDonald jar, as equipped with its discharge tube of glass and rubber, and the fry required to pass into the fry-tank through this, gives almost negative results with striped bass because the volume of water for these eggs—but one quart a minute—is insufficient to keep the rubber discharge tube filled. Hence the fry turn sommersaults in the passage down the incline to the tank, and are too badly shaken up to survive even though the sacs are not actually ruptured.

Finding pitcher-mouth or lipped jars also unsuitable for hatching, I bored in the McDonald jar, near the top and just below the shoulder, a smooth, round hole, and inserted a six-inch length of 7/16-inch rubber jar-tubing, tight fitting, a little more than flush with the inner surface of the jar, and when the fry emerged they passed into the fry tank through this tube rather than through the ordinary glass and rubber tubing from the top of the jar. This connecting tube was in horizontal position, the outer end inserted into the side of the fry tank by means of a ⅝-inch bit hole, a water tight joint being effected by the union of tubing and wood. Before hatching commenced the end of the tubing at the tank was closed with a bottle stopper of cork, whereby the jar was kept full and overflowing at the customary discharge point at the top, that being an open hole in consequence of the discarding of the rubber and glass tube heretofore employed as the exit for dead eggs and fry. When the eggs were ready to hatch the cork stopper was withdrawn, affecting the discharge of the jar through the horizontal rubber tube, water no longer passing out at the top of the jar, and the level of water in the jar dropping from the top down to the level of the horizontal rubber exit. The head of water was so regulated in the fry tank that the horizontal communicating tube was at all times submerged, whereby it was impossible for the fry to receive any shock or injury of any kind. The hatching result was all that could be desired.

It was long ago found that metal screens were totally inadmissible in tanks for striped bass fry, and recourse is had to fabric screens, cheese cloth or batiste made into carefully sewed bags which are drawn over the strainer or siphon cages and firmly tied. But these, until this year, were a part of the siphon employed to carry away the water from the fry tank. I have since discarded the siphon feature, as it was quite impossible, in large work, to employ this without destroying fry. The substitute consists of the same cage and bag and the same kind of ¾-inch stiff rubber hose, but differently arranged. A piece of the hose about a foot long is

thrust in a bit-hole in the side of the fry tank, making a water-tight joint, about an inch of the hose projecting on the outside and the longer part on the inside of the tank. To the inner or longer end the cage and bag are attached in the regular manner, this being accomplished by lifting the end of hose above the water surface of tank. More than one discharge is provided for a tank to allow for renewal of strainer bags while the tank contains fry. The rigidity of the hose holds the strainer away from the sides and bottom of the tank, where fry sacs would otherwise be crushed. As the outer end is fixed and an open orifice, the head of water in the tank is inevitably fixed at a given point, and is necessarily constant.

Thus, it will be noted that in the jar the customary discharge tubing is discarded, and in the fry tank the siphon feature and siphon cup are eliminated—a simplification in apparatus and the attainment of ideal results.

The tank head at the beginning of the season was 4 feet and 4 inches, afterward, almost unavoidably, increased to 5 feet and 2 inches. Another season I would reduce the tank head to 3 feet or less, for the avoidance of free air in the rubber and glass tubing connecting the jar with the water-piping, the free air being a phenomenon that is encountered every season when the greatest number of eggs are in the hatchery. Spawning, occurring at 69 to 70 degrees, takes place on a marked rise in temperature that is usually continuous for some days, and is attended with the free liberation of air from the water to a bothersome extent, slowly and almost imperceptibly charging the feed tubing of the jars with free air to the extent of reducing the flow of water and causing the eggs to become matted if neglected long. But it is not the matting of the eggs that gives greatest anxiety, rather is it the difficulty in actually keeping the flow of water up to the standard and yet not wash the eggs out of the jar. When there is air in the rubber tube and the petcock is correctively opened far enough to restore the inadequate flow in a jar, the attendant may have gone but a few feet away when it is dis-

covered that the eggs are overflowing from that jar into the sewer. The additional water he had turned on soon pushed the accumulated air out of the tube, and too much water was now being delivered. The petcock was already opened far enough, the obstruction being the air in the rubber tube, which he did not and could not see. It can be seen only when it accumulates sufficiently to reach down into the glass tube. The rubber and glass tubing devised for the McDonald jar contemplated the use of two quarts of water per minute and are too large in bore for the one-quart flow in striped bass hatching. By lowering the tank head I anticipate the using of more water, and, while avoiding the blowing out of the eggs from the jar, establish such an increase in volume and movement of water in the tubing as to minify the accumulations of air.

Before concluding this paper I wish to present an innovation in the removal of dead eggs from jars in the striped bass operations at Weldon, N. C., which may be more widely applicable. It has the advantages of speed, positive identification of good or bad eggs in transit, and simplification of apparatus. I discard the conventional discharge tubing of the jar, both glass and rubber, allowing the water to escape at the open hole at the top of the jar. When ready to remove dead eggs I take a short glass tube and place upon it one of the small rubber washers designed for the jar stuffing-boxes, placing the washer perhaps near the middle of the tube. Inserting an end in the jar at the waste-hole, it is hardly seated when the water overflows at its top. If the tube is not inserted far enough in the jar to induce the exit of dead eggs I press upon its upper end, when it slides smoothly downward through the washer until it has reached the proper depth and the outward passage of dead eggs may be observed. To make sure that these are dead eggs, note the single layer that gradually spreads over the metal plate which covers the top of the jar, the eggs having slipped down the outer surface of the glass tube to that point, where the outside ones are in turn pushed off by the succeeding ones.

There is just enough water around the eggs on the plate to afford a thorough inspection, although they are moving, the opaque discoloration being discerned with definiteness. But this is not all. By moving the tube and its washer up and down, by a gentle shaking motion, the outward passage of water and eggs is arrested at will, and an altogether satisfactory examination is entirely practicable. One person can look after a half-dozen of these tubes at one time and be free from anxiety as to the loss of good eggs, and if he is needed elsewhere he slips all tubes out and walks away, knowing that not another egg will pass until he reinserts the tubes. I accord the credit of this new and fascinating method to Mr. Wm. W. Spears, who has for a number of years been temporarily employed at Weldon. I had expected to use a siphon, of rubber and glass tubing united, but one of which, however, could have been operated at a time by one person.

If the foregoing methods of transferring fry from jar to fry tank and of removing dead eggs from jars can be applied to shad work, we shall witness the discarding of all jar exit tubes, both glass and rubber, at one stroke. The adoption of these methods would, of course, imply the using of the modified jar here described for striped bass hatching, viz, the jar with the fry escape through its side and through the 7/16-inch jar tubing. I think that these methods are certainly applicable to shad operations, but their adoption in that branch does not imply the discarding of the metal screens in fry tanks. Jars properly fitted for such work should, of course, be moulded with the side opening in them, for the drilling of the glass invites breakage.

At Weldon last spring 22 fish were stripped, producing 11,336,000 eggs, an average of 530,000, the weight of fish averaging 16 pounds and ranging from 5 to 50 pounds each. Eleven ripe fish were unstripped by inadvertence of fishermen. Each of the 22 lots of eggs produced more or less fry. All eggs were taken, fertilized, and delivered by the fishermen unaided, and paid for at the rate of $20 per million.

PROTECTING THE UNDERSIZED TROUT

By G. H. Thomson,
ESTES PARK FISH HATCHERY, ESTES PARK, COLORADO.

I desire to thank the Society at this time for the assistance given me at the Congress which convened last September in Washington by the indorsment of the recommendations I offered for the protection of the undersized trout.

I desire also to state a few of the facts which led me to take up the cause of the small fish, and which from my own personal investigation convinced me beyond a reasonable doubt as to the effect of grasping an undersized trout (which the law requires shall be returned to the stream) with a dry hand, when removing from the hook.

One year ago, I desired to have a couple of large trout to place in one of my hatching troughs, in order to compare them with the records; and also to show the beauty of the trout in their natural state. I caught, with a dip net, two yearling eastern brook trout from the stream that runs in front of the hatchery, and removed them from the net to a bucket of water by grasping them with a dry hand. Immediately my hand was covered with the slime from the backs of the fish. Several days after placing the fish in the hatchery, I noticed that a white fungus growth had begun to form upon their backs where I had grasped them with my hand. I watched them closely from day to day, and found that the fungus was increasing. I had observed fish in this condition before but did not have them where I could follow them.

When I have any trouble with my fish in the hatchery I always use salt in the water, as salt is a disinfectant. So I then prepared a strong solution of salt water in a pan and placed the fish in it, one at a time; one of them was overcome by the salt in three minutes, and I removed it to spring water, where it revived in ten minutes; the other one I held for five minutes in the salt solution, and it recovered in fifteen minutes time.

I watched the fish very closely from day to day, and found that I had checked the fungus, but I also found that I had destroyed the sight of the first one, so I killed it; the other one began to loose all of its outer coating and coloration, but after a few days it began to eat and the beauty to return, "like a bird molting." I kept it in my hatchery all of last summer, and showed it, an object lesson, the result of grasping with a dry hand. I have since caught this fish with my hand wet, hundreds of times without injury. I have the same trout in my hatchery at the present to exhibit its beauty.

From this experiment I was led to the printing of the cards, "A plea for the fish," for the education of the fisherman, but have found that some of our old and experienced fish men require enlightenment of this same kind. One denounces the proposition as "bosh," stating that he has had twenty years experience in the fish business, and has never found that condition to exist; but his statement simply goes to prove and support the position that I have taken, for he was speaking from the standpoint of a fish man, and when he handles spawning fish, he takes them from a tub of water, with hands always wet; but the fisherman takes the fish from the hook with his hands dry.

I never show the beauty of a trout here in the hatchery, without pointing out the effects and danger of the dry hand. I called upon the advertising agents of all of the railroads that run trains into our mountains during the fishing season, and urged upon them to insert in their advertising matter for this season the information as to how to handle a fish taken from a hook. They did so; and the work last summer in this direction is having its results this season, for the information given is being applied by the fishermen, and they are educating others. It is all a matter of education.

NOTES ON THE LEAPING OF THE PACIFIC SALMON

By Henry B. Ward,
university of illinois, urbana, ill.

Both story and song are replete with praises of the leaping powers of the salmon. The energy, grace and precision with which it is able to surmount the rocky barriers in its native streams are exploited by naturalist as well as fisherman until I think it fair to say that the general public regard it as exemplifying the most perfect natural development of the leaping power. All of these descriptions are written no doubt with reference to the Atlantic species, *Salmo salar*, which has a wide range along both coasts of the Atlantic Ocean, and since the time of the Romans at least has been the favorite of angler and epicure alike. Its peculiar right and title to the popular name has caused Professor Goode to write of it: "*Salmo salar*, the only true salmon in the whole group of nearly one hundred species of the Salmonidæ, has always stood preeminent, like a Scottish chieftain, needing no other name than that of his clan."

It has never been my good fortune to be able to observe the Atlantic salmon in its native haunts and I have no accurate data by which to measure precisely the accounts of its powers which appear in prose and poetry. Two years ago, however, I was privileged to spend some time under the auspices of the United States Bureau of Fisheries in the study of the Pacific salmon in Alaska and at that time made certain observations on the leaping power of the species (*Oncorhynchus nerka*) commonly known as the Alaska or red salmon. I am indebted to the Hon. Geo. M. Bowers for this opportunity and for permission to make use of the

data recorded here. While my observations are very incomplete and constitute only a fragmentary preliminary communication, yet they are positive in certain respects and afford an intersting comparison with the better known and more aristocratic Atlantic salmon.

As I am now on my way to Alaska to complete studies begun on that previous trip, it may be possible later to add more data to those already noted down on the jumping powers of this salmon. Meantime I should be indebted to any of the members who may be able to point me to published evidence concerning other definite observations on this or related species.

The observations recorded here were made about the middle of the run of salmon on Naha stream, near Loring, Alaska. About half way from salt water to Heckman Lake, in which these salmon regularly lie to ripen for spawning and on which the Alaska Packers Association has a large hatchery, one finds the only fall in the course of the stream which is more than a rapids. This is known as Dorr Falls and forms a straight drop about three or four feet high with only one break, near the left bank. Here a spur of rock leads out obliquely away from the crest of the fall in such a way as to give an unbroken flow of water about a foot lower than the general level above the fall. The salmon go up from salt water in bunches or schools, usually starting at the time of a heavy rain, which, owing to the character of the drainage basin, raises the level of the stream very promptly and markedly. When such a school has reached the deep pool at the base of the fall they apparently rest a short time and the following day may be found actively engaged in the effort to surmount the falls. While we watched the pool, the jumping seemed continuous, as if not merely a single fish but several at least were in the air at once, and it was only rarely that one could note any intermission between the jumps. Yet the camera gave evidence of the deception practiced on the eye. Of some thirty snaps taken at random when the jumping seemed most frequent, only six caught fish

in the air and only one of these showed two fish jumping. One optical illusion was thus effectively dispelled.

I was interested to see whether the fish chose any particular point of attack for the leap. As already indicated the fall was considerably lower at one place and the jump necessary to reach solid water above was consequently much shorter. Yet so far as I could tell within the time of my observations, fewer fish tried the fall at that point than at others either right or left of it. I was inclined to believe that the point of attack was determined largely by the depth of the water below the fall. At least the shallowest points were those from which the fish did not jump, and the extreme left of the stream where the water was quietest and certainly very deep was also one of the most frequented jumping places. It was also the place where the fall was most perpendicular and highest. At the same time it must be recorded that some fish were seen jumping all along the entire line of the fall and that the preferred point of attack seemed to shift from one half hour to the next.

It was difficult to determine the height of the jump made by the salmon. There was hardly a single case in which a fish jumped higher than the crest of the fall and in nine out of ten cases at least the jump was not high enough to reach the crest. The fish dashed frequently right through the sheet of falling water and struck head first against the face of the rock with sufficient force to stun them so that they were carried away disabled, floating down stream some distance before they recovered sufficiently to start in swimming again. Even when trying at the low point of the fall they often landed on a rock, bounding off against another point only to be carried down by the rush of water.

The length of the jump was very variable, as also the starting point of the leap. At times a salmon rose from the water near the face of the fall and again one came from the smoother waters some distance back from this point. In the latter case even a long fine jump resulted only in bringing the fish down head first among the rocks at the base of the fall.

I was fortunate enough in one photograph to catch such a salmon just as he dropped head first into the mass of foam and rocks.

One of the most striking features of the salmon leaping was a distinct lack of directness. Many of the jumps were made at an oblique angle which rendered the effort ineffective. Some were directed towards the bank, some parallel to the line of the fall. In a few cases I even saw a salmon shoot out of the pool, make a splendid jump directly away from the face of the fall and land far out in the open water. The type of jump was exactly like that used in making the fall and entirely unlike that observed in open water when the salmon are entering estuaries or passing through fresh water lakes, so that one is forced to conclude that the leaping salmon is at times diverted from the proper direction by unexpected swirls or currents in the water or is unable to judge correctly the direction for a correct leap as well as the height and length necessary for effective work, or finally makes some leaps aimlessly without due regard to the end to be attained. All things considered, the jumping of the Alaska salmon at these falls made upon me the impression that there was a clear lack of definiteness as well as accuracy in the efforts made for the attainment of its purpose.

It may be well to say here a word concerning the leaping of the salmon in open waters away from falls or other obstacles in its path. I have observed the pink salmon jumping on various occasions in the salt water of Behm Canal, of the estuary near Loring and in two lakes of the Naha stream. The fish jump sidewise from the water; the body is bent slightly so as to be concave toward the direction from which the fish comes; the vertical height reached is relatively small and the fish merely falls back nearly flat on the surface of the water with a splash which recalls the "belly-whopper" of our boyhood days at the old swimming hole. In this case, however, the fish lands flat on the water, side down. There is no leap from the water and subsequent dive head first into it as in the case of the true jump at the falls. I have tried thus far

in vain to photograph a fish in this posture in the air, and have succeeded only in catching the splash. A photograph of the head of the inlet loking into Roosevelt Lagoon, where a school of salmon were waiting for the proper tide to enter the lagoon and start the ascent of Naha stream, shows at the right a splash which by its form and extent indicates that the fish has landed flat on its side with the head towards the left of the observer. The pink salmon always make this characteristic splash when jumping in open water and the jump itself in extent, direction, termination and posture of the fish is in positive contrast with the leap made at the falls. It is not at all like the jump of a salmonid seeking a fly and I have never seen a similar leap in any other species. Apparently its aimlessness suggests sport or moderate excitement due to mild and ill-defined stimuli. It cannot be confused with leaping at the falls and cannot be easily related to the latter or derived from it.

Finally a few notes were made on the posture of the fish when attempting to surmount the falls. As the salmon emerges from the water the body is rigid and during the very brief interval of the aerial flight manifests no movements that can be detected. The dorsal surface is usually slightly concave, although in one case the reverse was apparently true. I think the former is characteristic of the successful leaps and perhaps of all at the start while the latter is seen near the end of a jump and so far as I could observe is infrequent at best. As the salmon sails on through the air one can easily see that the lateral fins are expanded and set at an angle towards the side which makes of them wings or organs for soaring and they remain in this position even in unsuccessful attempts until the fish reaches the water.

The powerful strokes of the caudal fin made when a salmon reaches the solid water at the crest of the fall have often been observed and commented upon as the means by which the fall is finally surmounted and the quiet water beyond is attained. I observed this action often in case of the red sal-

mon but can add no items of importance to the records of other observers.

I have been influenced to bring this imperfect study before the Society in order chiefly that I might benefit by the observations and suggestions of a group so skilled in the study of fish under natural conditions.

THE INVASION OF THE POTOMAC

By Henry Talbott,
WASHINGTON, D. C.

To those who have known the Potomac well it has always been one of the greatest of fishing streams. Strange to say, the fishes for which it was once famous have now nearly disappeared, and it is fished now for an alien stock, for most of its biting population has been imported.

The following interesting extract from Captain John Smith's narrative is evidence of the early date at which the river was asserting its eminence:

> They afterwards went up the river as high as they could with their boats and were received in some places kindly, and in others in a hostile manner. Up a small river then called Quiyough, which I take to be Potowmack Creek, was a mine like Antimony. In this the Indians dug, and washing away the Dross in a clear Brook, which ran by, they put the Remainder in little Bags, and sold it all over the country, to deck their Bodies, Faces, and Idols, which made them look like Blackamores dusted over with Silver. Newport had carried some of these Bags home, and assured them that they were found upon trial to contain half silver. Being therefore very eager after this mine they obtained Guides from Japazaws, King of Potowmack, who lived at the mouth of that little River and went up to it; but all they got, proved of no value. Towards the Falls of Potowmack, they met several parties of Indians in Canoes, loaded with the Flesh of Bears, Deer, and other wild Beasts, which they generously imparted to them; and in divers Places, they saw that abundance of Fish, lying with their Heads above water, that their Barge driving among them, for want of a net they attempted to catch them with a frying-Pan, But they found that a bad instrument to catch Fish.

It is interesting to note that the antimony mine with whose glitter the dusky dandies silvered their bronze bodies was not on Quiyough, which is the present Acquia Creek, but on Quantico, 10 miles above, then called Ochquayo River, and navigable for their light draft sea vessels to Dumfries, five miles above. And the mine a couple of miles beyond is not

antimony, but a low grade pyrites—still commercially worked, now 1400 feet in depth—which furnished the chests of "fool's gold" which the school histories tell us some of the early explorers hopefully carried back with them to England.

Another colonist from Jamestown came still higher up the river, and spent a season among the friendly Indians on the Eastern Branch opposite Washington where he saw taken at night, off the site of the present steel works on Giesboro Point, a great catch of sturgeon. And Captain Smith, of some unlocated point says: "There was once taken 52 sturgeons at a draught and at another 68." However, net fishermen resented the sturgeon's destructiveness when caught in their gill nets and seines, and waged war on young and old; carrying a ready billet always to dispatch them. Sturgeon fishing was up to thirty years ago quite an industry at points down the river; a few are yet picked up in drift nets in the Potomac, and their capture is of considerable importance in Chesapeake Bay, but they have practically disappeared from the river where they were once so plenty.

John Colegate, before the fifties, one of the oldest writers on fly-fishing on this river, tells of catching shad with the fly at Long Bridge, and incidentally that the shad averaged then 14 pounds in weight. They now hardly average above 4½ pounds and are scarce at that.

Thomas Hariot, in 1588, said: "For Foure monethes of the yeere February, March, April and May there are plentie of sturgeons and also in the same monethes of Herrings, some of the ordinary biggeness as ours in England, but the most part [shad] farre greater, of eighteene, twentie inches, and some two foote in length and better.' Both these kindes of fishe in those monethes are most plentifull, and in best season, which we founde to bee most delicate and pleasaunt meate."

Notwithstanding the efforts of the Fish Commission in hatching shad and stocking the river—which is prolonging the industry—it is naturally bound, with the great increase in population and the fences of nets all the way to the ocean,

to decline. Once a seining shore on the Potomac was worth thousands of dollars, but the seines now cut out earlier each year, and the business becomes more precarious and less profitable all the time.

When the spring is backward, the weather cold and dark, the fish ascend the river in the channel, ten fathoms deep, and only come out over the netting grounds and gravel beds when the water is warm and the weather bright; but when the school makes its first excursion to the shallows it encounters a stake net, a seine, a fyke, or a drift; and these miles and miles of nets shut the fish from the upper river, while the nets in the bay even dam them from the river, so that this year's entire catch in the river was less than a quarter million, not one per head for Washington alone.

But the sturgeon, herring, and shad are not the only fish for which the Potomac was early famous. In "Superior Fishing," printed in 1865, in the chapter on striped bass, occurs the following:

> Fly fishing for Bass, however, is the perfection of the sport, and infinitely surpasses in excitement all other modes of killing these noble fish. The best season on the Potomac is in July or August, and the favorite hours the early morning or the twilight of the evening. The ignorant and debased natives who inhabit the romantic region of hill and valley in the neighborhood of Tenally Town, about five miles northwest of Washington, and who, dead to the beauties that nature has lavished around them, and utterly unacquainted with scientific angling, look merely to their two cents per pound for striped bass; manufacture a fly by winding red or yellow flannel round the shank of a large hook, adding sometimes a few white feathers. They substitute for a rod a young cedar sapling, denuded of bark and seasoned by age, and attaching to the upper end a stout cord, fish with the large flannel-swathed hook in the rapids and below the falls of the Potomac, at the old Chain Bridge, and without a reel kill bass of twenty or thirty pounds.
>
> No spot can be imagined more wild and romantic, and with proper tackle, the reel, the lithe salmon rod, and the artistic fly—no sport can be more exciting. The roar of the angry flood, the bare precipices topped with foliage on the opposite bank, the flat, dry bed of the stream where it flows during the heavy freshets, but at other seasons a mass of bare, jagged rocks, and the dashing spray of the broken current lend a charm to the scene, while the fish, rendered doubly powerful by the force of the stream, and aided by the numerous rocks and falls, have every chance to escape.

The bass pursue the silvery herring, which is the principal natural bait, and ascend the Little Falls of the Potomac during the summer months in vast numbers. They are captured in such quantities with the net in the salt water and with hook and line in the rapids, as to be almost a drug in the market.

As the season advances, the native crawls upon some rock that reaches out into the stream and with his coarse but elastic cedar pole, casts the roll of flannel wrapped round a hook and misnamed a fly, into the seething current, and when the brave fish seizes the clumsy allurement, the fisherman contends for the mastery as best he may, occasionally at the risk of a ducking in the stream consequent upon the sudden breaking of his tackle, and accompanied with considerable risk. When a man has but a slight foot-hold upon the slippery surface of a shelving ledge, and has attached to the end of his rod a vigorous fish of twenty pounds, he is apt to fall if the line parts unexpectedly. Many are the tales of such accidents, and now and then of fatal results. Generally speaking bass are not fished for with the fly north of the Potomac.

But the river is still a delight to fishermen and on a single day a few weeks ago it was estimated that 5,000 men and women were playing at fishing, lining the rocks on both banks, from Georgetown to Little Falls, and fleets of small boats dotting the stream from Chain Bridge down. Probably never in the history of the river were so many lines out in this reach, and they were cast in pleasant places, but there was a spate on and the fish were off their feed, or frightened by the invading army, and few fish were caught.

Now for the new fish that are found here. In the lower river, that is, tidewater below Little Falls, are found the red and silver ides, only caught with net and called locally sand perch. Plump tench are caught occasionally, up to a pound in weight, on worms. Goldfish are common and have gone back to original type, an olive bronze in color and nearly always mistaken for young carp. They are taken only with the net, and are a favorite bait for the big-mouth bass.

All these are only novelties and attract no fishermen, but the entire lower river is fished to brackish water for big-mouth bass, which, brought here from Illinois and reaching nine pounds in weight, have taken on entirely new habits in tidewater. These big-mouth bass were taken with a spoon in quantities every month of the past winter in the

tidal basin at the foot of Washington Monument, up to 4 pounds 10 ounces in weight—18 taken by one boat on February 22.

Native trout have always been caught in the tributaries of Difficult Run, and a couple of these little runs have been preserved and overstocked, the surplus running out into the Potomac. Dozens have been taken this season below the Little Falls, but only Simple Simon would go trout fishing in the Potomac.

In the upper river, between the two falls, hundreds of thousands of the yellow pike perch or wall-eyed pike have been planted, but so far have not rewarded the angler's efforts to locate them.

Rock bass, or goggle-eye, from the west, are common in the upper Potomac, and in seining the Chesapeake and Ohio canal one winter the Bureau of Fisheries found hundreds of these fish and restored them to the river, though not many are reported as caught in these waters. Their cousin, the warmouth perch, also introduced from the west by the Bureau, is found in every tidewater pool of the lower river, and are caught every fishing day on the fly by local anglers, using bass tackle.

Crappie there are in respectable plenty from western rivers; the upper river is full of small-mouth bass from the original stocking, before the war, from Wheeling Creek, and numerous plantings since from the Mississippi Valley; Mississippi or spotted catfish occur in large numbers about the Great Falls, of good size and growing in popularity for their gameness and flavor. With these, by accident, were also planted specimens of the fork-tailed or channel cat of the Mississippi, which reaches the weight of 150 pounds in its home waters, and has been taken here of 30 pounds.

Carp from China via Germany—that is always a red rag to the prejudiced—is a source of much enjoyment, and food to one class of fishermen, and since its young are the main dependence of the bass for food, ought to have the toleration

of the most artistic or prejudiced angler. Without them the less bass.

So, in conclusion, the native shad, sturgeon, striped bass, and even herring are flitting, and in their places the river is locally famous for a set of fishes that are imported from other climes and other waters.

REPORT OF THE COMMITTEE ON FOREIGN RELATIONS.

In this, its third report, the Committee on Foreign Relations presents to the Society certain matter relating to fish culture and fisheries in Russia, Germany, and New Zealand. The information regarding fish culture in Russia has been furnished by request by Mr. Nicholas Borodine, honorary member of the Society, and late chief specialist in fish culture in the Department of Agriculture, St. Petersburg, Russia. The data for the German Empire are based on various articles appearing in German fishery publications and translated for the present purpose by the chairman of the committee. Some of the results of fish acclimatization in New Zealand have been communicated by Mr. L. F. Ayson, a corresponding member of the Society; and a note on the progress of fish culture in Argentina has been received from Mr. E. A. Tulian, an active member of the Society.

FISH CULTURE IN RUSSIA.

The Russian government has one central fish-cultural station at Nikolsk, Government of Novgorod, established by the well-known Russian fish culturist, Vrassky, discoverer of the dry method of artificial fecundation of fish eggs in 1854, and purchased by the government from the said Vrassky in 1869. Here is a hatchery for trout eggs—a copy of the oldest in Europe, at Huningen, Alsatia. At Nikolsk the building is of good size, but as operations are conducted along old-fashioned lines, the output is small. The station is 40 kilometers from the railroad. There are many suitable ponds for trout, also a large lake. The

scientific part of the work is well arranged. There are a biological laboratory (now, however, without a biologist) and a chemical laboratory. The laboratory has issued numbers 1 to 9 of the periodical "Contributions from the Nikolsk Laboratory," containing many good papers. At the laboratory during the summer a number of young men are engaged in the study of practical fish culture.

There are in addition three auxiliary government fish hatcheries. One is in St. Petersburg in connection with the Agricultural Museum, where rainbow trout and sturgeon are hatched; and another, with an annual capacity of 800,000 salmon eggs, is at the mouth of the Luga River not far from St. Petersburg. A peculiarity of this latter hatchery is that fecundated eggs are kept out of water. On a layer of eggs in Coste's hatching box is placed a bed of cotton, which is sprinkled with water three times a week. Of course, when the fry are nearly ready to hatch, a current of water must be supplied. This method of incubation was recommended by Dr. Oscar von Grimm and five years' experience on a large scale has demonstrated that the eggs develop well, the loss being less than in the ordinary manner. The third branch station is in Dorpat. The *Coregonus baeri* (resembling the whitefish of the United States) is hatched here, the capacity being one million. The Weiss hatching jar is used.

The above covers all that the government is doing in fish culture. The hatching of salmon on the Curo River was attempted, but without success, and the fish-cultural station established there is now closed. Experiments with sturgeon (*Acipenser ruthenus*), from a practical standpoint, were a failure.

There is no station for carp culture, although for a long time the establishment of one has been under consideration. The government has made no appropriation for this work, but it is hoped that in time there will be a station for distributing carp fry—a matter of great importance to certain districts. In Poland and Estland there are a large number

of very good carp ponds, but none that are operated by the government. The work at these private ponds is in general very well done.

As fish in Russia are becoming very scarce and high in price, Mr. Borodine is endeavoring to have fish-cultural work conducted on a large scale under an organization like the U. S. Bureau of Fisheries. There is no special bureau for fish culture, such work being attended to by the Department of Agriculture, one of the branches of which is in charge of fisheries, fish culture, game culture, bee culture, and the rearing of silk worms. Only 5 persons are engaged in all this work, 3 being specialists in fish culture and fisheries, and one inspector of fisheries, all consulting specialists with no defined duties. Beginning with 1907 an advisory fish committee was organized at the Department of Agriculture; the members are special officers of the department and two are also representatives of the Russian Fisheries Society.

The Russian government appropriates about 800,000 roubles (1 rouble=about $0.55) annually for fish culture, exclusive of the salaries of regular employes, whose compensation ranges from 600 roubles for fish culturists to 3,000 roubles for the chief specialist.

The output of the hatcheries is generally distributed as fry. There is no gratuitous distribution, but a charge is made at the rate of about 3 roubles for 1000 fertilized trout eggs or for 100 fry. The transportation facilities by railroad are so poor and the cost so high that the eggs and fry are bought only by very wealthy men.

Data showing the extent of fish culture in Russia are very incomplete. The annual output is very small, as may be judged from the following statistics of the fertilized eggs in the Nikolsk hatchery and its branch at St. Petersburg:

Year.	Salmo salar	Salmo truttæ	Salmo salvelinus	Coregonus baeri
1881	65,000	64,800	2,500	401,500
1895	150,000	200,000	2,000	500,000
1898	80,000	220,000	3,000	1,000,000
1901	85,000	200,000	10,000	1,000,000
1903	———	200,000	———	1,200,000

The number of private fish hatcheries in Russia does not exceed 10 to 12. They handle the same species as the government stations, but their output is not known. Practical results from both private and government work are reported to be insignificant. American rainbow trout have been introduced in Kiev from Germany, catfish in Nikolsk for aquarium culture, and large-mouth black bass in limited numbers in a few places.

FISH CULTURE AND FISHING IN GERMANY.

Germany undoubtedly leads all European countries in the extent of its fish-cultural work. Statistics collected in 1895 show that in the entire German empire there were at that time 12,623 persons engaged in inland fisheries and fish culture, and 71 per cent of these, or 8,956, made this their principal occupation.

Fish culture in Germany is mainly a matter of private enterprise, and the sale of fish for food is the ultimate source of the fish culturist's income and support. Many districts in Germany are thickly sprinkled with natural lakes, which are largely utilized, and there is a very great area of artificial ponds.

The fishes cultivated belong to many species, grouped in several families, mainly the Salmonidæ and Cyprinidæ. Two leading fish journals, in their issues of January, 1909, contained the advertisements of 103 persons or firms offering for sale young fish and eggs for stocking purposes: 9 of them offered Salmonidæ in general; 54 specified European brook trout; 41 American brook trout; 2 sea trout; 2 lake trout; 43 rainbow trout; 4 purple trout; 3 European saibling; 1 coregonoids; 4 grayling; 1 Danube salmon; 34 carp; 24 tench; 7 goldfish; 2 higoi (a kind of Japanese

goldfish); 1 American sunfish; 2 black bass; 2 smallmouth black bass; 2 stone bass; 2 pike; 4 pike perch; 2 American horn pout; and 5 eels.

An inspection of nine issues of three fishery journals in January and May, 1909, discloses the advertisements of 20 persons or firms offering fish food for sale, under the following names: fish-roe, fishmeal, "fishmeal aki", fishmeal "Ideal", Hering's fishmeal, Schlutup fishmeal, Naegel's fishfood, fleshmeal, food-fish-meal, food-flesh-meal, "Radical pond food", rice-food-meal, rye-food-meal, lupines, "Lupiscin", "Cyprinin", etc. In several instances the above advertisers state the composition, in part, of their food articles. For instance, the "Fishmeal Aki" is said to contain 60 to 70 per cent phosphate of lime; the "food-fish-meal" 65 to 70 per cent protein. Lupiscin is a patented article composed largely of lupines. Cyprinin is a mixture consisting of 40 parts lupiscin, 40 parts fishmeal and 20 parts loam (or clay). Apparently there is good sale and extensive use of many of these articles.

In the markets many species are sold for consumption, those from fresh water in a single market report in June being carp at 77 to 92 marks for 50 kilograms (or 8 1-2 to 10 cts. per lb.); tench at 23 to 102 marks (or 2 1-2 to 11 cts. per lb.); pike at 25 to 123 marks (or 2 3-4 to 13 1-2 cts. per lb.); eels 21 to 135 marks (or 2 1-4 to 14 3-4 cts. per lb.); and salmon at 92 to 121 marks (or 10 to 13 1-4 cts. per lb.). The favorite way of selling fresh-water fishes in Germany is from tanks of water, alive, and the lowest price quoted above is in each case the price of fish not sold alive, except the carp, of which no dead fish were offered that day, and salmon, of which only iced fish were on the market.

There are many fishery societies in Germany, nearly all of them being especially interested in fish culture. The leading society is the Deutsche Fischereiverein, which geographically covers the whole realm. Other general societies are the Seefischereiverein (or Society of Sea-fisheries); the

Verein Deutscher Teichwirte (or Society of German Pond-culturists); the Verein Deutscher Fischhaendler (or Fish Dealers' Union); the Verein der Fischindustriellen Deutschlands; and the Verein der Privatbeamten der Teich-wirtschafts und Fischereibetriebe Deutschlands (or Union of Private Officers of Fish Ponds and Fishing). There are upwards of 50 societies of a more local character that are sufficiently active to have their proceedings reported in the journals. There is also a general council of fishery societies, the Fischereirat, which meets annually, from whose pro-ceedings in June, 1909, extracts are here given.

There are four fishery journals published in Germany twice a month or oftener, besides one in the German language in Austria and another in Switzerland.

Instruction is given by courses of lectures and demonstra-tions ("Lehrkurse") and by traveling boards ("Wander-lehre"), the officers of which can be summoned to make local examinations as the basis of advice on questions of fish culture. Of these lecture courses there were ten announced in the Allgemeine Fischerei Zeitung in 1908, and two of the traveling boards were advertised.

Public support of fish culture is given from time to time in the form of subventions to the fishery societies, the German Fischereiverein acting usually as an intermediary, dividing the subventions when necessary among the minor societies. These subventions are generally made for specific purposes. Thus, in 1908 the imperial government granted 21,780 marks for the following purposes:

For distribution of salmon and sea trout in the littoral districts of the Baltic Sea, 3,000 marks ($720); for the importation of eel fry from England for the stocking of German waters, 8,500 marks ($2,040); for the production and liberation of salmon fry in the Rhine and its tributaries, 3,959 marks ($950); for the production and distribution of salmon fry in the Elbe and tributaries, 5,571 marks ($1,337); and for the investigation of north German waters, 750 marks ($180).

A fishery convention resulted from the assembling at Dresden in June, 1909, of the German Fischereirat, the German Fischereiverein and the Saxon Fischereiverein, the last in celebration of its twenty-fifth anniversary. The Fischereirat held its seventeenth session, and considered a number of matters of special importance, including reports on the fish-cultural work of the affiliated societies, on the introduction of eels, on problems in pond culture, etc.

Following is a summary of the fish planted and eggs furnished by the affiliated German societies under imperial subventions aggregating 34,000 marks, as reported at the Dresden convention:

Species.	*Number.*
Grayling	40,000 eggs; 45,000 fry.
Rainbow trout	98,450 fry; 8,900 yearlings.
Lake trout	1,600 yearlings.
Lake saibling	12,000 fry; 1,800 yearlings.
American brook trout	34,000 fry; 250 yearlings.
European brook trout	99,000 eggs; 657,000 fry, plus fry for 250 marks; 12,000 yearlings, plus yearlings for 250 marks.
Danube salmon	1,100 yearlings.
Whitefish	517,000 fry; 1,512 yearlings.
Pike	7,500 fry; 1,590 yearlings, plus yearlings for 50 marks.
Carp	1,025,000 fry, 51,000 yearlings, plus yearlings for 625 marks; 5,614 2-year olds, plus 2-year olds for 65 marks; 2-year olds of 2,170 pounds weight; 230 3-year olds; 60 spawners.
Tench	10,016 yearlings; 2,600 2-year olds, plus 150 pounds weight.
Pike perch	32,000 fry, plus fry for 140 marks; 30,020 yearlings; 200 pounds of spawners.
Eel	1,000 fry, plus fry for 234 marks; 18,000 fingerlings, plus 13,500 pounds of fingerlings.
Plaice	10,000 eggs.
Crawfish	15,100, plus crawfish for 41 marks.

The propagation and distribution of salmon and sea trout under the direction of the German Fischereiverein and allied societies had the following extent in 1909. In the Rhine district the salmon-egg harvest was extraordinarily large, and contrary to the usual experience the lower Rhine as well as the middle and upper districts was very productive.

Waters stocked.	*Number.*
Rhine and tributaries—salmon fry	1,994,740
Elbe and tributaries—salmon fry	1,239,058
Weser and tributaries—salmon fry	1,257,749
Ems and tributaries—salmon fry	196,350
Oder and tributaries—salmon fry	30,000
Weichsel and tributaries—salmon fry	116,950
Baltic Sea and tributaries—salmon fry	126,940
Baltic Sea and tributaries—sea trout fry	134,260
Baltic Sea and tributaries—sea trout fingerlings	19,500
Total	5,115,547

CHINOOK SALMON IN NEW ZEALAND.

Extracts from a letter from L. F. Ayson, Commissioner of Fisheries, Wellington, New Zealand, dated August 30, 1909:

You will be pleased to learn that the chinook salmon are showing up first rate in our rivers. Several have been caught by anglers during the trout season at the mouth of the Waitaki River, and we had quite a good run of spawning fish up in 1908 and again this year. The first spawning salmon came up in 1906, and the run has been better every season since then. We find that most of the fish spawn in the large tributaries of the Waitaki and in the main river itself; and we have traced them right up to the lakes at the head of Tekapo River and through Lake Ohau, and have found them spawning in the rivers which flow into the lake. Very few fish come into the smaller streams, such as the Hakataramea, to spawn; and as it is only in the smaller tributaries that we can trap or net them our collection of eggs has not amounted to much. This season we took 238,000 eggs from fish ranging from 8 to 26 pounds in weight. The eggs were as large as those

we imported from Sacramento salmon, and they hatched out splendidly. So far we find that the salmon begin to spawn about the second week in April, and that they are all finished by the end of May. These months would correspond with October and November with you. Would you call this an autumn or winter run? I understand that all the salmon eggs we had from America were from winter-run fish.

You probably know that we put all the salmon hatched from imported eggs into the Waitaki River, and we now find the fish spreading along the coast and going into other rivers. Young salmon of one pound weight have also been caught by fishermen in some of the bays along the east coast, so there is every probability of all the rivers which are suitable along that section being stocked with them.

PROGRESS OF FISH CULTURE IN ARGENTINA.

An interesting note on some of the results of fish acclimatization in Argentina has been sent by Mr. E. A. Tulian, national fish culturist. The first fish eggs were hatched in this country in January, 1904; and an account of the inception of the work appears in a previous number of the Transactions. Under date of June 3, 1909, Mr. Tulian wrote that up to that time the season's take of American brook trout eggs was 300,000, and that 200,000 to 300,000 additional eggs would probably be obtained. These eggs are from wild fish. Many fine examples of brook trout and land-locked salmon have been caught, one female brook trout weighing 5 pounds and measuring 18 inches, and a female land-locked salmon measuring 16 inches in length; these fish had recently spawned. At another stream several brook trout 14 inches long were taken, one a female full of eggs. The trout have been planted from the streams of the Andes directly north of the Patagonian border of Argentina to its most northern province, which is entirely in the tropics; the mountains being so high as to have snow to keep the streams cool in mid-summer of a tropical climate.

QUESTION BOX.

QUESTION 1.—What advancement has been made in small-mouth bass culture since last year?

MR. CLARK: While perhaps as near as I can determine there has been no marked progress, we have had an experience at Northville that seems to merit more than passing notice. We now have some two-year-old small-mouth bass raised at Northville that spawned this spring. They are fish reared from fry hatched two years ago in our ponds. This season they spawned. Possibly this may be considered an advancement in small-mouth bass culture. In any event I believe that hereafter we should get our breeders by raising them.

MR. JOHN W. TITCOMB: From my office at the Bureau of Fisheries in Washington I can see marked progress in a general way in the propagation of small-mouth black bass, simply in the results attained. It is no longer the problem that it was when first undertaken only a few years ago. The small-mouth bass is just about as easily propagated as the big-mouth bass and some think it is even easier. We are producing a large number of fingerling small-mouth bass. This year the output will be much greater than ever before.

PRESIDENT: May I be permitted to call attention to one thing in relation to the small-mouth black bass that may not be known to all of our members. Up to a year or so ago we in New York were under the impression that the small-mouth black bass especially could not be placed in ponds just prior to the spawning season and produce a good crop of young. During the last two years at the Chautauqua Station, and at the Constantia Station on Oneida Lake, we took bass from Chautauqua and Oneida Lakes just about when they were ready to spawn, or a day or two in advance of actual spawning, and put them into the pond prepared for spawning, and they went ahead about their business just as though they had lived there all their lives. We were very greatly surprised and gratified at this, for now we are not obliged to keep a great stock of brood fish in our ponds. We simply go to the lake, take out the fish when they are gravid and almost ready to spawn, put them into the ponds, get the young, and then let the old fish go. We are under no expense for the care or watching of the fish during the winter or at any time. Another thing which surprised me somewhat was the late date of spawning of the small-mouth bass at Constantia, New York. We took two nests of young which were just hatched on the 2nd of July, and I learned that the spawning actually continued beyond the middle of July.

Mr. Dwight Lydell: We have put into practice at the Mill Creek station during the past two seasons a plan that has proved so successful that every bass nest is productive. In the fall we put our brood fish into a storage pond which is deeper than the others, and the fish are held there until just before they are ready to spawn. There are no nests or spawning places in this pond and the fish are too much crowded to spawn even under more favorable conditions, and they are held there with a big flow of water until danger of the spawn being destroyed by cold weather is past. In the meantime spawning ponds are prepared, nests set and everything made ready for the time when spawning cannot be postponed any longer. This season it was the 11th of May before we decided that the fish must be put into the spawning ponds. Within four or five hours after they were transferred nearly every bed had been spawned on and every bed used produced fry. The fish had plenty of minnows in the storage ponds, all they wanted to eat, and were in the pink of condition when put into the spawning ponds. Results were highly successful. There was not a single unproductive nest out of 75. Of course in a latitude where the water warms up and stays warm, results would no doubt be satisfactory without holding the fish in a storage pond. At Mill Creek, however, we almost invariably have several days of cold weather following a period warm enough to induce spawning. Again, early in the season we are liable to have days when the water warms up enough in the middle of the day to cause the fish to spawn, yet during the night it becomes so cold that the eggs are killed. In a word, the idea or plan of crowding the parent fish into a storage pond is to prevent or postpone spawning until we are certain that the temperature of the water will not drop below the danger point. Perhaps this plan is not necessary at southern stations or in warmer latitudes, but it works out very successfully in the northern part of the country.

Question 2.—Has any new method been discovered for removing algae from water?

Mr. Titcomb: I suppose the question has reference to some other method than the use of copper sulphate.

President: Yes.

Mr. Titcomb: I know of none.

Question 3.—Should minnows be introduced into black bass breeding ponds as food for the bass?

Mr. Lydell: During the spawning season we do not allow anything there but adult fish. The minnows would be very detrimental to the young bass. We put no minnows in our breeding ponds at any time of the year unless they are dead. The fewer live minnows you have in the pond the more natural food there will be for your bass fry.

Mr. Clark: At what period do you introduce food for your adult fish?

Mr. Lydell: Do you mean minnows in the storage pond?

Mr. Clark: Yes.

Mr. Lydell: In the fall of the year and at no other time. Just now we are feeding liver to the adult bass.

Mr. Titcomb: Would you introduce the minnows in the fall of the year?

Mr. Lydell: We put large numbers of live minnows in our storage pond every fall. What the bass do not eat in the fall they have when they come out of winter quarters, but when the breeders are put into spawning ponds they have no live minnows. They spawn at once and we commence feeding them immediately after screening the beds. Many fish culturists forget their old fish after they have their young. The parent fish must be well fed in order to produce a nice lot of fry the next season. It is necessary to begin feeding right away after spawning.

Mr. Clark: Mr. Lydell breeds both large and small-mouth bass. We breed nothing but the small-mouth at Northville, so anything I say applies to small-mouth only.

Mr. Lydell: My statements also refer to small-mouth bass.

Mr. Clark: At Northville we handle small-mouth bass in much the same manner as described by Mr. Lydell. The fish are put into a storage pond in the fall with plenty of minnows, and when taken out in the spring they are given no minnows. At other times the food is principally liver. Possibly a few minnows are fed if the fish get a little thin on the liver diet. With reference to the question of liver, why should we not feed it extensively to small-mouth bass the same as to trout? There is no difference between feeding small-mouth bass and trout, so far as I can see.

Mr. John E. Gunckel: Why is it that when these educated, liver-fed black bass which you deposit in the streams are fished for with liver by my class of people we cannot catch a black bass, but land instead a catfish or bullhead?

Mr. Clark: We do not distribute our adult liver-fed fish. The little fish, the fingerlings, never have any artificial food.

Mr. W. H. Safford: Where do you get your stock fish from?

Mr. Clark: I just stated that we are now raising them ourselves. Heretofore we have taken them from native waters, but hereafter we propose to raise them.

Mr. Safford: Were your wild fish fed with liver from the beginning?

Mr. Clark: We got them to take liver as soon as we could.

Mr. Safford: We have both the large and small-mouth bass but cannot induce either species to take liver at any time of the year.

Mr. Clark: Then you are not using the right kind of liver.

Mr. Safford: We have both the beef and the pork.

Mr. Lydell: Your liver is out of order. (Laughter.)

QUESTION 4 (by Mr. Titcomb).—In the propagation of either large or small-mouth bass, have any of you found that tadpoles take possession of the nests to such an extent that the parent fish leave in disgust, and the eggs are spoiled and eaten by the tadpoles?

MR. SAFFORD: Not that I have noted.

MR. TITCOMB: Let me give you the experiences of two or three of the Bureau's superintendents. The superintendent at Erwin, Tennessee, thinks tadpoles consume quantities of eggs and that the frogs eat fry. Mr. Seagle, of the Wytheville, Virginia, station, does not believe that the tadpoles destroy good eggs, and he looks upon them as desirable scavengers. Mr. Robinson, superintendent of the hatchery at White Sulphur Springs, West Virginia, first brought the matter to my attention in the propagation of small-mouth bass. Mr. Robinson says he regards the tadpoles as very destructive, for they swarm in large numbers around some of the nests, and as far as he has been able to observe, the nests so surrounded have not produced a single fish. I tried to ascertain whether the tadpoles took possession of nests of blighted or poor eggs but was unable to do so. Mr. Johnson, of the Manchester, Iowa, station, states that apparently they do no harm except perhaps a few days before the bass spawn, and that they are too small to do serious damage to the eggs. He states that they frequent shallower portions of the pond and do not go into deeper water until quite large. He thinks they may consume minute animal life which would serve as food for the bass. Mr. Carter, of the St. Johnsbury, Vermont, station, never regarded them as enemies, but fears they consume vast numbers of insects that would otherwise be valuable as food for the fish. He thinks it well to raise frog tadpoles in separate ponds and says that the bass will not touch the tadpoles of the toad. But the information from Mr. Robinson is quite convincing that tadpoles sometimes become so numerous that they actually take possession of bass nests. I should like all who are interested in pond culture and have an opportunity to do so to make observations along this line, especially because it seems to me a great reflection on the bass if he allows tadpoles to take possession of the nest while he is on guard.

MR. H. D. DEAN: I have seen a strawberry bass rid his nest of tadpoles by sucking them into his mouth, swimming away from the nest and then ejecting them. I do not believe any of the basses will take toad tadpoles. Last Monday we drew down a pond of strawberry bass and found almost as many frog tadpoles as bass. I do not believe they do any harm unless through eating minute animal life, nor do I think they drive black bass off the nests.

MR. W. E. MEEHAN: The toads are so abundant at one of our stations that they are a nuisance. The bass do not seem to touch them but they clean up the frog tadpoles quite lively in other ponds; there is any quantity of toad tadpoles in the bass ponds untouched.

Mr. Lydell: Does Mr. Titcomb refer to the frog or toad tadpole?

Mr. Titcomb: Both.

Mr. Lydell: I consider them a nuisance, because they prey on good as well as poor nests. The tadpoles were often so numerous around the nests that we have thought at times when screening a nest that there were more of them than bass. Some three years ago I found that by going out in the evening with a lantern we could easily gather up the adult toads. In a single evening with the help of two men I gathered up a common sugar barrel full, which did away with the tadpoles for that season.

Mr. Safford: Do you mean the term tadpole to include the toad as well as the frog?

Mr. Titcomb: Yes, the toad eggs are produced in the water the same as frog eggs.

Mr. Safford: The term tadpole applies exclusively to the frog, according to my understanding.

Mr. Meehan: There is a tadpole of the toad also.

Mr. Lydell: Every year before the spawning season we prevent the tadpole nuisance in the manner described above.

Mr. Charles W. Burnham: Did you remove the eggs that were spawned by the toad, too?

Mr. Lydell: If any were there we did. They are found in long strings and may easily be gathered up and destroyed.

President: We have done it for years.

Mr. John E. Gunckel: I fish a great deal in the upper waters of the Maumee. We have both the small-mouth and the large-mouth bass, but the large-mouth are quite plentiful in the big pond a few miles above the rapids. When the tadpoles are of good size, we go up on the rapids and catch more bass than with any other kind of bait. I refer to the common green frog tadpole. I have not time to tell you how large fish I catch. I will tell you that later. (Laughter.)

Question 5.—What number of adult black bass brood fish per acre is considered best to produce the largest number of fingerlings numbered 1½ and 2?

Mr. Lydell: That is a very hard question to answer. At the Mill Creek station we get the largest number from 40 to 50 pairs; at some other bass stations it might require a much larger number.

Mr. Ward T. Bower: This question relates I believe to the large-mouth bass, although it merely states black bass on the slip before me.

Mr. Meehan: It is generally understood as meaning the small-mouth.

Mr. Ward T. Bower: At the Washington office of the Bureau of Fisheries the expression "black bass" refers to the large-mouth, and when the small-mouth is meant it is so specified.

Mr. Meehan: In Pennsylvania the local phrase is black bass for small-mouth bass.

Mr. Fullerton: How many feet apart would you put the nests?

Mr. Lydell: We used to put them ten, then twenty, and now thirty feet apart, and are getting more fish at present than when they were ten feet apart. Formerly we put thirty or forty pairs of bass in a pond 60 by 150 feet; but now we use only fifteen pairs and get more fingerlings and more good nests than ever before. I am speaking of small-mouth bass. Of large-mouth bass we had last year twenty-five pairs in a pond 300 by 250 feet, and got about 225,000 number 1 and between 15,000 and 20,000 number 2 fingerlings. This year we increased the number of brood fish, putting in sixty pairs, and as a result we have taken to date only about 30,000 number 1 and no number 2 fingerlings. There are only a few left in the pond, which shows that the increased stock of brood fish decreased the output.

Mr. Fullerton: That bears out our experience in Minnesota. We overstocked at first with too many breeders, which I realize was a mistake. I agree with Mr. Lydell that more bass will be produced if the nests are placed thirty feet apart.

Mr. Ward T. Bower: This question as to the proper number of brood fish per acre depends to a large extent on local conditions. There is no advantage in hatching more fry than the natural food supply will support.

Mr. Lydell: The number of adult fish or fry in a pond depends entirely on its condition. In some ponds where food is very plentiful we get double the number of fingerlings that we do from others twice its size, simply because there is twice the amount of food. Every fish culturist must be his own judge on this point.

Question 6.—Have any experiments been undertaken towards the propagation of aquatic food for fish in streams?

Mr. Meehan: As the one who put this question in the box, I may state that in Pennsylvania we are in a rather peculiar position, or rather a good position in one sense, in that we are beginning to prevent the pollution of the streams. At one time in Pennsylvania we probably had the worst polluted streams of any state in the country, but in the last two or three years there has been a change of sentiment. The people do not now believe in making their streams open sewers; and the Department of Health and Department of Fisheries have in hand the purification of the waters. The laws are very sweeping and strong, and we are beginning to prevent pollution. Over one hundred establishments have been cleaned up by the Department of Fisheries within the last two months, and it comes now to a question with us, as we get the streams clear, of providing food for them, because if the food is not there we are not going to have fish. Has anything been done or have any experiments been carried on with a view of restoring food life in the waters in the shortest possible space of time? Of course I am well aware that certain aquatic plants like chara and fontinalis grass

and certain potamogetons are good food producers, but even that is not enough in some instances for us; and I should like to know whether anything has been done along this line, or in the line of propagating minnows, crayfish or anything else that would produce fish food.

PRESIDENT: Are there any further remarks on the question of the propagation of aquatic food for streams?

MR. MEEHAN: Has the Federal Bureau done anything in this direction?

MR. TITCOMB: No, I think not. We are now collecting aquatic plants from our trout stations, and propose to collect them from certain trout streams, with a view of gaining further knowledge as to which plants are best and which may be considered objectionable; also as to how to regulate their growth, somewhat on the same order as the work which resulted in a paper on aquatic plants in pond culture. I wish to explain, by the way, that this is a subject that I know very little about, and made bold to write on merely to bring out the fact that so little is known, and in the hope that some plant physiologist will take up the subject and go on with it for two or three years or until we know definitely more about it.

MR. MEEHAN: I would like to illustrate particularly what I am after and where I need the assistance of the Society. We have, for instance, among other streams in Pennsylvania, one known as the Clarion River, which rises in Elk County and flows through that county for many miles, and is for part of the distance quite a large stream. There is today not a living thing in it from source to near the mouth. All life has been destroyed by pollution from paper mills, tanneries, chemical works and things of that sort. Now, we hope to have this river clear inside of the next twenty-four months, so that it may be in a condition to support fish life, which of course cannot be maintained unless food is there. It is not a trout stream except in the extreme upper end; but warm water fishes will live in the main river, and its possibilities are very great given the absence of pollution. Looking forward to this work, I am very anxious to have the advice of the Society as to methods of food propagation, because it will be necessary for us to establish aquatic life to support fish life in streams, particularly like the Clarion River. It is a herculean task before us, but it is one that should arouse the interest of everybody in the work.

MR. FRANK M. MILLER: How are you going to stop the pollution?

MR. MEEHAN: By fining those who violate the law.

MR. MILLER: What will you do with the pollution?

MR. MEEHAN: It is not a question of dollars and cents, and besides, it can be used at a profit; it is a question of aquatic food, and that is above dollars and cents.

PRESIDENT: I suppose Mr. Meehan will agree that insect life will come without help on the part of man, but the plant life will have to be introduced, also some crustaceans and shells perhaps.

DR. EVERMANN: The best thing will be to provide as early as possible certain places along the river where plant life may be established—

marshes that connect with the river, and coves where vegetation cannot be carried away.

Mr. Meehan: We are nearly rid of refuse from tanneries along that stream, and this is one of the worst forms of pollution. A large paper manufactory has received notice to put in a separation vat within sixty days.

Question 7.—Are applications for fish increasing or decreasing annually?

Mr. Titcomb: In the year 1902 when I first took my position in Washington, D. C., we averaged something like 2,500 applications for fish annually. The number received each year has steadily increased until the fiscal year just ended showed something over 10,000. Had we recorded them as we did in 1902 the number would have been much greater, for at that time it was common for a dozen or twenty applications to be filed for a single lake, while today we file only one application, cancel the others and notify the applicant of the action taken.

Mr. Fullerton: That is the case in Minnesota. Applications have increased fifty per cent in the last ten years. In regard to applications received by the government I believe it would be a good plan for the Bureau of Fisheries to refer them to the boards of fish commissioners of the several States for recommendations. The Bureau of Fisheries may not be in a position to know as well as local fish commissions what kind or kinds of fish are best adapted to the waters applied for; hence I believe that the local boards should be consulted.

Mr. Titcomb: We are taking more and more precautions every year to see that fish are not wasted. When there is any doubt about the suitability of a particular species of fish for any definitely named body of water, as described on the application, it is referred to the commissioner of fisheries of the State in which this water is located. In addition to this precaution of referring the applications to State fish commissioners where there seems to be some doubt as to the advisability of granting a request, or where the applicant is very persistent and is dissatisfied with the species assigned, the Bureau is making a card index of all the important waters for which fish are supplied. To the extent that we can secure the information the results of plants are entered in the card index three or more years after the fish are delivered. To obtain the information special inquiry blanks are distributed to those who applied for or planted the fish. This, of course, is a big undertaking, but I believe that the government can well afford to devote considerable time and money to the compilation of such an index. In the course of time the Bureau will thus have a valuable record of the results of its work. I think when you appreciate the amount of work being done in this direction you will realize that the Bureau is taking every possible precaution to see that the fish are not wasted.

Mr. Fullerton: What I said about the Bureau was not in a spirit of criticism as I think it is doing a great work. I suggested the reference

of applications to State boards with a view to making the Bureau's work still more effective. In Minnesota we have adopted this card system and have been working at it three years. Every lake and stream in the State is now indexed. We know their depth, size, the kinds of fish in them, etc.

Mr. Seymour Bower: In Michigan the number of applications has increased rapidly and particularly in the last five or six years. We use a blank form of application and three to four thousand of these are filled and returned yearly. This does not include hundreds of renewal requests nor requests to make applications perpetual. We also fill brook trout applications three successive seasons whether reapplied for or not; so that in one way or another we have from 5,000 to 7,000 requests and applications before us for consideration annually.

Mr. Meehan: Applications for fish in Pennsylvania are increasing very rapidly. The number last year for black bass was only half what it is this year. The demand for trout is also increasing. We do not renew an application; a blank must be filled out for each lot of fish. Requests for an extra supply of fish are likewise increasing. It is not uncommon for an applicant to ask for forty cans of fish for a mile of stream.

President: The applications for fish are increasing rapidly every year in New York. Last year we had more than four thousand, which is about one thousand more than the year before.

DISCUSSION ON YELLOW PERCH

Mr. Ward T. Bower: It occurs to me that the yellow perch is well worth consideration at this time. I may be something of a yellow perch crank even as we have our bass and trout cranks. If so, my enthusiasm is due to the high place which I think this excellent food and game fish deserves. In order to stimulate a little discussion, I have at the suggestion of Dr. H. M. Smith, of the Bureau of Fisheries, brought a jar containing some yellow perch ova, which perhaps you will be interested in seeing. As you will notice, the eggs are in the form of strings or ribbons. These are green eggs and they retain this general appearance practically throughout the period of incubation. It is interesting to know that generally a yellow perch weighing say a pound will deposit a ribbon of eggs which a few hours afterwards will weigh twice as much as the fish. Contrary to the general belief that yellow perch eggs are embedded in or held together by a membrane, you will observe, upon careful examination, that they are merely attached one to the other; and after hatching there is practically no residue. In hatching jars the ribbons stand up very much after the fashion that they do in this container. I think it was Mr. Clark who told me that he had difficulty in supporting the ribbons in jars. Often they collapsed and fungus and other troubles developed to the extent that the eggs were practically a total loss. This may have been due in a measure to very cold water or other unfavorable conditions, but so far as I know these troubles have not been experienced elsewhere. I trust that we may have a free discussion on this point.

It is worth noting that we have changed the standard of measurement for yellow perch eggs. In a report issued twelve or fifteen years ago I think the statement is made that perch eggs measure at the rate of 28,000 per quart. At the present time the Bureau is recording them at the rate of 130,000 per quart, quite a difference from the early standard.

Mr. Titcomb: I was thinking that it was a little less than that.

Mr. Ward T. Bower: Quite recently it was determined by actual count and otherwise that the average number per quart is 130,000.

Mr. Meehan: In our measurement we made between 70,000 and 80,000, but I dare say you have been able to give more time and study to it than we did. I know the Bureau is not apt to over measure its eggs.

Mr. Ward T. Bower: No doubt there is considerable variation in the number per quart, according to locality, size of fish, etc., as in the case of brook trout.

Mr. Titcomb: I think that 100,000 is a very conservative measurement.

Mr. Meehan: What is the longest ribbon you have seen in your experience?

Mr. Ward T. Bower: Eighty-eight inches, I think.

Mr. Meehan: Our longest string was seven feet four inches—same length. It weighed nearly five pounds. Do I understand that there has been some trouble in handling yellow perch in jars, and that a fungus growth has prevented the eggs from hatching?

Mr. Ward T. Bower: I have not seen anything of the kind, but Mr. Clark told me a short time ago that he has experienced some such difficulties.

Mr. Meehan: We had little or no trouble in handling the eggs either before or after they were put in the jars, provided we did not put too many in a jar. A Downing jar will carry four quarts safely and with no tendency to settle. At a certain period after the strings separated the eggs had a tendency to rise like dough and go over the top of the jar. This was overcome by putting a piece of mosquito netting around on the inside of the jar. If further trouble was experienced we turned the water off and allowed the eggs to settle, after which the water was slowly turned on again. Sometimes they would rise a second time, but not often. Occasionally the mass of eggs would get thick and when hatched the fry had some trouble in getting free of the mass, but the loss was very small, not worth considering. If the eggs were dirty we washed them. The dead eggs were removed without injury to the rest. This cannot be done with pickerel eggs. You cannot touch the latter after they are in the jars. We found that neither yellow perch nor chain pickerel eggs could be successfully hatched in spring water. They would die within twenty-four hours, whether the temperature of the spring water was 48, 50 or 52 degrees Fahrenheit. If the spring was far enough away for the water to become aerated there was no trouble.

Mr. Ward T. Bower: We have had very little difficulty in the propagation of yellow perch. At the Bryan Point station on the Potomac River, where several hundred millions were handled this year, the percentage hatched was over ninety-five.

Mr. Meehan: We get about ninety-five per cent of hatch.

Mr. Ward T. Bower: In addition to its direct value as a food and game fish, the yellow perch is very prolific and therefore furnishes an important source of food for black bass and other predaceous species.

Mr. Meehan: At my suggestion, the Blooming Grove Park Association in Pennsylvania has put up a hatchery to hatch large numbers of these fish.

Mr. Titcomb: I understand that the yellow perch is perhaps more easily propagated than any other species. Simple methods and apparatus answer the purpose, and a large flow of water is not necessary. The eggs may be hatched in an aquarium, a trout trough or any equally simple device; but to handle the eggs to the best advantage and with a knowledge of just what you are doing, the open jar seems to be the best. The Bureau is now hatching them in this manner at several stations.

And by the way, speaking of propagating perch as food for bass, one

of the men at a field station has been transferring perch fry to a station pond and raising them for bass food.

Mr. Ward T. Bower: The reason why I referred to possible troubles in connection with the propagation of yellow perch is that Mr. Clark has on two or three occasions called attention to the difficulties experienced in handling the eggs in jars, and I thought this might bring out something of benefit to him and others who may have had similar troubles.

Mr. Clark: Our experience in hatching yellow perch has been so limited that I do not think it is of any great value. I may say, however, that Mr. Thayer, foreman of the Detroit hatchery, placed the eggs in jars and undertook to hatch them in the way that is said to be so easy and they all died. However, when we suspended the ribbons in the jars we hatched from 80 to 95 per cent. At any rate we assumed that we hatched about 90 per cent because this proportion showed the eye spots and the moving fish. No doubt as Mr. Titcomb says it is an easy matter to hatch perch eggs provided the ribbons do not settle to the bottom of the jar.

Mr. Meehan: We do not string the ribbons across the jars but put them in the same way as other eggs, and we have no trouble at all.

Mr. Clark: I would like to hear from Mr. Lydell on this subject.

Mr. Lydell: I did not intend to say anything about the yellow perch. I am hardly ready. We have been experimenting with them at the Mill Creek station a couple of years and have five hundred breeders there at and the fry. The eggs hatched most successfully the past season and were handled in this way: we placed two ribbons in each jar and kept them there until two or three days before hatching, when they were transferred to our large fry tanks. Seine twine was strung back and forth across these tanks about an inch apart and the same distance from the bottom, thus forming a rack for the ribbons to cling to or rest on. When everything had disappeared from the twine we knew we had a large hatching percentage. But when we held the eggs in the jars until they hatched, the fry in the bottom found it very difficult to swim up through and escape from the gelatinous mass. They became tangled up and smothered. Nearly half of the hatch was lost in this way, which is not very profitable.

This season I tried a galvanized tank for hatching perch. This tank has three sets of wire trays in it, half inch mesh, on which the spawn is placed. The water is introduced from the bottom of the tank, which is rounding, and in such a way as to insure uniform circulation. This worked to perfection until the eggs hatched, when if we did not take the fry out they commenced to die. Then I introduced another pipe to carry the young fish up and out with a strong current of water. This worked well with not to exceed a million of eggs in the tank. But that is not entirely satisfactory, because we want a tank that will handle 10,000,000 eggs.

We hatched and distributed five or six million fry at Mill Creek this year, and are now working on a plan to raise them to fingerling

size before shipping. We have shipped 20,000 number 2 fingerlings and have 10,000 to 15,000 on hand. They take ground liver readily, are now two and one-half inches long and growing very fast. They come into shallow water and feed freely from the bottom of the pond. We are much encouraged in the work.

Mr. Titcomb: I wish to supplement my remarks about how easily perch eggs are hatched by saying that where one is not particular about knowing the actual number hatched, perhaps the simplest and most economical method of handling them is in floating boxes. Go to any lake or river where perch are taken during the spawning season, put your floating boxes in, fill them with eggs and let nature take its course. You simply save the eggs and protect them until they hatch.

Mr. S. W. Downing: Mr. Titcomb's method is all right if the water is clear, but if it is as roily as it was this season in Lake Erie, the eggs will become so loaded with silt that they will settle to the bottom and smother. We had at our station this spring something like ten and a half million perch eggs in Downing jars, two and a half quarts to the jar, and during most of the time we had to feather them twice a day to remove the silt.

Mr. Titcomb: Where floating boxes are used it is better to have them in a current such as that of a river. In a lake or where there is no current I think that roily water would cause trouble.

Mr. Downing: The water was unusually roily this year.

Mr. Titcomb: Under such conditions the eggs would have to be feathered.

Dr. Barton W. Evermann: Mr. Bower asked me a question regarding the geographic distribution of yellow perch. It is abundant all across the northern portion of the United States from New Brunswick to the Lake of the Woods and perhaps Lake Winnipeg, and then south through the lakes of Minnesota, Iowa, and the eastern part of the Dakotas; in Northern Illinois, Northern Indiana and all through the Great Lakes region. I think it is not native anywhere south of middle Indiana in the Mississippi Valley States, although it has been occasionally taken in the Wabash River. It is found down the Atlantic coast to the Potomac and perhaps slightly beyond. It has been introduced on the Pacific coast and is now abundant about Seattle and the various lakes in Washington, Oregon and California.

I notice in a paper recently prepared by the Census office, giving the fisheries product of the State of Oregon, that the catch of perch in Oregon was quite large. I know from personal observation that the yellow perch is very abundant in Washington, Union and Greenwood lakes and various lakes about Seattle.

To what extent the yellow perch may be introduced in more southern waters, of course, remains to be determined. The way to find out is to try it. But it is not a river fish in the Mississippi Valley as it is along the Atlantic coast, where it is both a lake and river fish.

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ACTIVE MEMBERS

Adams, Oliver, 55 Glen Road, Toronto, Ont.
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Babcock, John P., Deputy Fisheries Commissioner, Victoria, British Columbia, Canada.

Bailey, Nelson, Wells River, Vt.

Baldwin, O. N., U. S. Bureau of Fisheries, Leadville, Colo.

Ball, E. M., U. S. Bureau of Fisheries, Afognak, Alaska.

Barbour, Thomas, Museum of Comparative Zoology, Cambridge, Mass.

Barrows, A. L., Cavite, Philippine Islands.

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Bower, Seymour, Superintendent Michigan Fish Commission, Detroit, Mich.

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Brooke, Charles F., Sandy Springs, Md.

Brown, George M., care Pere Marquette R. R., Detroit, Mich.

Brown, G. W. N., U. S. Bureau of Fisheries, Baird, Cal.

Brown, Thomas, Salmon, Ore.

Brown, Thomas W., Glenwood, Minn.

Brush, Dr. E. F., Mount Vernon, N. Y.

Brush, Dr. H. L., Conneaut Lake, Pa.

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Burnham, Edwin K., U. S. Bureau of Fisheries, Washington, D. C.

Burrows, John C., Lake Toxaway, N. C.

Campbell, G. D., Weymouth, Mass.

Canty, J. C., Galveston, Texas.

Carleton, L. T., Chairman Board of Inland Fisheries and Game Commissioners, Augusta, Me.

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Casperson, Thorgrim, U. S. Bureau of Fisheries, Yes Bay, via Ketchikan, Alaska.

Casselman, E. S., Kamp Kill Kare, Raquette Lake, N. Y.

Catte, Eugene, Langdon, Kan.

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Clark, Fred, Michigan Fish Commission, Comstock Park, Mich.
Clark, Walton F., Westerly, R. I.
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Dean, Herbert D., U. S. Bureau of Fisheries, Bozeman, Mont.

Degler, F. A., Sportsman's Association of Cheat Mountain, Cheat Bridge, W. Va.

Detwiler, John Y., Honorary President Florida Fish Commission, New Smyrna, Fla.

Delaney, O. J., Moorestown, N. J.

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Donahue, L. H., Leadville, Colo.

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Fullerton, Samuel F., St. Paul, Minn.

Gavitt, W. S., Lyons, N. Y.
Geer, Dr. E. F., St. Paul, Minn.
Geer, E. Hart, Secretary State Commission of Fisheries and Game, Hadlyme, Conn.
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Green, Dr. D. W., Board of State Fish and Game Commissioners, Dayton, O.
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RECAPITULATION

Active	395
Life	14
Honorary	72
Corresponding	20
Total Membership	501

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this Society. In case members do not pay their fees, which shall be two dollars per year after the first year, and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponing member upon a two-thirds vote of the members present at any regular meeting.

The President (by name) of the United States and the governors (by name) of the several States shall be honorary members of the Society.

Any person shall, upon a two-thirds vote and the payment of twenty-five dollars, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a president and a vice-president, who shall be ineligible for election to the same office until a year after the expiration of their term; a corresponding secretary, a recording secretary, an assistant recording secretary, a treasurer and an executive committee of seven, which, with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session—four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the executive committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by president.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Standing Committees.
5. Committees appointed by the president.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
6. Reading of papers and discussion of same.

(Note—a. In the reading of papers preference shall be given to the members present.

b. The president and two secretaries are empowered to arrange the papers of the meetings of this Society.)

7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said regular meeting.

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